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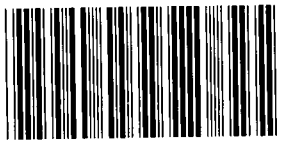
Style, Content and Format Guide for Writing Safety Analysis Documents

Volume 1: Safety Analysis Reports for DOE Nuclear Facilities



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STYLE, CONTENT AND FORMAT GUIDE FOR WRITING SAFETY ANALYSIS DOCUMENTS

Volume 1: Safety Analysis Reports for DOE Nuclear Facilities

Sandia National Laboratories
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June 1994

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Sandia National Laboratories

Sandia Contract No. AG-5801

Abstract

The ***purpose*** of Volume 1 of this 4-volume style guide is to furnish guidelines on writing and publishing Safety Analysis Reports (SARs) for DOE nuclear facilities at Sandia National Laboratories. The ***scope*** of Volume 1 encompasses not only the general guidelines for writing and publishing, but also the prescribed topics/appendices contents along with examples from typical SARs for DOE nuclear facilities.

ACKNOWLEDGEMENT

This document is intended to be a resource for preparers and writers of safety documentation for Sandia National Laboratories' nuclear facilities. Technical contributions were made by J. A. Mahn, W. H. McCulloch, L. F. Restrepo, K. R. Boldt, and B. F. Estes. D. G. Rikli of Shipley Associates, Bountiful, Utah, provided style guidance.

PREFACE

This Volume 1 is the first of four volumes that comprise the *Style, Content and Format Guide for Writing Safety Analysis Documents Guide*. The four volumes that comprise the Guide series are as follows:

- Volume 1: Safety Analysis Reports for DOE Nuclear Facilities (SAND93-7047/1)
- Volume 2: Safety Analysis Reports for DOE Non-nuclear Facilities (SAND93-7047/2)
- Volume 3: Safety Analysis Documents for DOE Accelerator Facilities (SAND93-7047/3)
- Volume 4: Safety Analysis Documents for DOE Environmental Restoration, Decontamination, and Decommissioning Activities (SAND93-7047/4)

  NOTE: Volumes 2 to 4 will be developed when appropriate guidance is issued on the format and content of safety analysis documents for non-nuclear facilities, accelerator facilities, and environmental restoration, decontamination, and decommissioning activities.

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LIST OF FIGURES

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GLOSSARY OF TECHNICAL TERMS

Term	Definition
Authorization Basis	Those aspects of a facility design basis and operational requirements relied upon by DOE to authorize facility operation. The authorization basis is described in documents such as the facility Safety Analysis Report and other safety analyses; hazard classification documents; Technical Safety Requirements, Technical Specifications or Operational Safety Requirements; Basis for Interim Operation; DOE-issued safety evaluation reports; and facility-specific commitments made in order to comply with DOE orders or policies.
ACRR	Annular Core Research Reactor.
ALARA	As Low as Reasonably Achievable.
APS	American Physics Society.
BDBA	Beyond Design Basis Accident—An accident of the same type as a distinct design basis accident (DBA), but defined by parameters exceeding in severity the parameters defined for the distinct DBA.
Commitments	Design, operational, or institutional factors that are adopted or otherwise assumed by the facility owner/operator in establishing the authorization basis for the facility or operation.
CSA	Criticality Safety Analysis.
DBA	Design Basis Accident—An accident postulated for the purpose of establishing functional requirements for safety-related structures, systems, components, and equipment.
DBE	Design Basis Earthquake.
D&D	Decontamination and Decommissioning.
ESF	Engineered Safety Feature.

GLOSSARY OF TECHNICAL TERMS (CONTINUED)

Term	Definition
EG	Evaluation Guidelines—Guidelines expressed in terms of dose (radiation) or exposure (hazardous materials), for the purpose of evaluating the adequacy of the results associated with design basis accident analyses; offsite EGs relate to protection of the offsite public and define needed safety-class SSCs; onsite EGs define additional safety-significant SSCs, controls, and procedures needed for worker protection.
GIF	Gamma Irradiation Facility.
HCF	Hot Cell Facility.
HED	Human Factors Engineering Deviations.
HRA	Human Reliability Analysis.
NEPA	National Environmental Policy Act.
NIST	National Institute for Standards and Technology (formerly National Bureau of Standards).
OBE	Operating Basis Earthquake.
ORPS	Occurrence Reporting and Processing System.
P&ID	Piping and Instrumentation Drawing.
PSO	Program Secretarial Officer
SAR	Safety Analysis Report—A report documenting the adequacy of safety analysis for a nuclear facility to ensure that the facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations.
Safety-Class SSCs	Structures, systems, and components whose preventive/mitigative functions are necessary to maintain dose/exposure within offsite Evaluation Guidelines (EGs).

GLOSSARY OF TECHNICAL TERMS (CONTINUED)

Term	Definition
Safety-Significant SSCs	Structures, systems, and components not designated as safety-class, and whose preventive/mitigative functions are necessary to maintain dose/exposure within onsite Evaluation Guidelines (EGs).
SOP	Safety Operating Procedure.
SPMS	Safety Performance Measurement System.
SSCs	Structures, Systems, and Components.
SSE	Safe Shutdown Earthquake
TSRs	Technical Safety Requirements—Those requirements defining the conditions, safe boundaries, and management/administrative controls necessary to ensure the safe operation of a nuclear facility and to reduce the potential risk to the public and facility workers from uncontrolled releases of radioactive materials, from other hazardous material, and from radiation exposures due to inadvertent criticality.
UBC	Uniform Building Code.
Unmitigated Release	Release of a hazardous material in which the functional performance of active consequence-limiting preventive or mitigative safety features is not considered; credit can be taken for passive safety features in limiting such a release.
USGS	United States Geological Survey.

GLOSSARY OF TECHNICAL TERMS (CONTINUED)

Term	Definition
USQ	Unreviewed Safety Question—A situation arising from a proposed action that results in any of the following: • Increases the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety as previously evaluated in the safety analyses. • Creates the possibility for an accident or malfunction of a different type than any evaluated previously in the safety analyses. • Reduces the margin of safety as defined in the basis for the facility Technical Safety Requirements.
Verification	The act of confirming, substantiating, and assuring that an activity or condition has been implemented in conformance with specified requirements.
Validation	Assurance that an activity or task has correctly achieved its intended purpose or objective.

CHAPTER 1

GENERAL GUIDANCE ON

SNL SAFETY ANALYSIS REPORTS

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CHAPTER 1: GENERAL GUIDANCE ON SNL SAFETY ANALYSIS REPORTS

1.1 INTRODUCTION

SARs must not only provide required technical content, but must present it in a high-quality style.

Personnel assigned to develop data for safety analysis reports (SARs) for DOE nuclear facilities at Sandia National Laboratories (SNL) must be familiar with the guidelines governing the required technical content for SARs. Often overlooked, however, is the importance of presenting this technical content in a **style** that simplifies the DOE review process and facilitates DOE approval. SNL is therefore issuing this Volume 1 style guide to help avoid nonapproval of SARs due to stylistic shortcomings.

NOTE: This volume does not provide exhaustive guidance for the technical content of SARs. Preparers and writers of SARs should also consult other applicable documents to ensure completeness.

The SAR format selected for SNL nuclear facilities is the prerogative of the author.

The format used in this style guide is acceptable for SNL nuclear facility SARs. However, this format should not be viewed as "required." Preparers and writers should consult other applicable documents, such as DOE-STD-3009-93, and the Risk Management and NEPA Department before deciding on the best format to use. Achieving consistency among SNL nuclear facility SARs is a desirable goal; however, the format chosen for the SAR is the prerogative of the author and is subordinate in importance to document content.

1.2 OBJECTIVES

Style guide objectives are designed to lead to high-quality SARs that warrant DOE approval.

The objectives for *Volume 1: Style Guide for Writing Safety Analysis Reports for DOE Nuclear Facilities* are:

1. Help SNL personnel prepare and write SARs that meet not only DOE-required content guidelines but also state-of-the-art stylistic standards;

2. Provide guidance on applying the *graded approach* to determine the content of a SAR; and

3. Establish consistent style and format to facilitate development of SNL safety documents and their internal review and approval.

SARs that reflect the standards fostered by these objectives are more likely to achieve DOE approval than those that do not reflect these standards.

1.3 SCOPE

Volume 1 encompasses four chapters and three appendices that contain general and specific information to help writers prepare SARs.

The focus in Volume 1 is on stylistic instructions rather than on technical content. Volume 1 does contain technical content of the kinds prescribed by federal reference documents and normally found in SARs. However, this technical material is generally not as detailed as that found in guidance documents that specifically focus on SAR technical content requirements. The technical content presented is used mainly to provide instructions about documentation **style** techniques.

Volume 1 consists of four major chapters and three appendices:

1. Chapter 1 — General Guidance on SNL Safety Analysis Reports. This chapter contains information on the general philosophy of Volume 1 and establishes the bases for using this guide.

2. Chapter 2 — Contents of SNL Nuclear Facility Safety Analysis Reports. This chapter offers guidance to help preparers and writers of SARs to:

   - Provide technical content in the topic format prescribed in DOE Order 5480.23, *Nuclear Analysis Safety Reports*, including application of the graded approach using guidance from DOE-STD-1027-92, and

   - Display the technical content in a way that meets state-of-the-art stylistic standards easily achievable using available computer software.

3. Chapter 3 — Publications Guidelines for SNL Safety Analysis Reports. This chapter has guidance on preferred grammar style, format, and desk top publishing techniques.

   NOTE: Stylistic standards are based on *Shipley Associates Style Guide*, Revised Edition, reprinted 1992.

4. Chapter 4—Appendices. This chapter explains the contents of the three appendices at the end of Volume 1.

5. Appendix A: A Guide to Applicable Statutes, Rules, and DOE Orders.

6. Appendix B: A Guide to Principal Health and Safety Criteria.

7. Appendix C: A Guide to PSAR vs FSAR Content.

1.4 REFERENCE DOCUMENTS

Various statutes, rules, and regulations govern the safety basis and operation of nuclear facilities.

Preparers of SARs must become familiar with the various statutes, rules, and regulations governing the safety basis and operation of a nuclear facility.

NOTE: Throughout this style guide, the word "facility" refers to a facility, process, or operation.

Appendices A and B at the end of this style guide present guidance in locating applicable codes, standards, DOE orders, and other safety requirements made law by federal, state, and local governments.

Referencing of these documents along with citation in SARs of site-specific or facility-specific policies and procedures are thereafter considered to be *commitments* by the facility owner/operator to the regulating agency. Therefore, such references and citations must be well-focused and limited to specific aspects related to control of the hazards or operational safety issues at the site or facility.

Each chapter of a SAR should contain its own reference section. Also, the SAR should contain a **master cross-reference matrix** that links references noted in SARs to the references cited.

Safety-related documentation referenced in the SAR should fall under the same document control system as the SAR. The objective is to ensure that any changes to references will be evaluated in the same depth as the SAR itself.

SAR management should include an administrative record of supporting SAR documentation to ensure that all applicable documents are reviewed in order to determine the impact of a change.

Site-specific support documents (e.g., policies, procedures, or documents involving data applicable to multiple facilities) may be referenced in a SAR. These then become subject to the same review and update requirements as the facility SAR, which is required to undergo annual review.

1.4.1 Reference Documents for General Safety Guidance

The main federal reference documents governing nuclear facility safety are:

10 CFR 830
DOE 4330.4A
DOE 5000.3B
DOE 5400.3
DOE 5400.5
DOE 5480.5
DOE 5480.6
DOE 5480.11
DOE 5480.19
DOE 5480.20
DOE 5480.21
DOE 5480.22
DOE 5480.23
DOE 5480.24
DOE 5480.28
DOE 5500.1B
DOE 5500.2B
DOE 5500.3A
DOE 5700.6C
DOE 5820.2A
DOE-STD-1027-92
DOE-DP-STD-3005-93
DOE-STD-3009-93
29 CFR 1910.119
29 CFR 1910.120

The three federal documents providing primary general guidance on content and preparation of SARs for nuclear facilities are the latest issues (including all changes, attachments, and memoranda) of:

Document	Title
10 CFR 830.110	*Safety Analysis Reports*
DOE Order 5480.23	*Nuclear Safety Analysis Reports*
DOE-STD-1027-92	*Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*

1.4.2 Reference Documents for Secondary Safety Guidance

The federal documents providing nuclear facility safety requirements are the latest issues (including all changes, attachments, and memoranda) of:

Document	Title
DOE Order 4330.4A	*Maintenance Management Program*
DOE Order 5000.3B	*Occurrence Reporting and Processing*
DOE Order 5400.3	*Hazardous and Radioactive Mixed Waste Program*
DOE Order 5400.5	*Radiation Protection of the Public and Environment*
DOE Order 5480.5	*Safety of Nuclear Facilities*
DOE Order 5480.6	*Safety of Department of Energy-Owned Nuclear Reactors*
DOE Order 5480.11	*Radiation Protection for Occupational Workers*

Document	Title
DOE Order 5480.19	*Guidelines for the Conduct of Operations at DOE Facilities*
DOE Order 5480.20	*Personnel Selection, Qualification, Training and Staffing Requirements at DOE Reactor and Non-Reactor Nuclear Facilities*
DOE Order 5480.21	*Unreviewed Safety Questions*
DOE Order 5480.22	*Technical Safety Requirements*
DOE Order 5480.24	*Nuclear Criticality Safety*
DOE Order 5480.28	*Natural Phenomena Hazards Mitigation*
DOE Order 5500.1B	*Emergency Management System*
DOE Order 5500.2B	*Emergency Categories, Classes, and Notification and Reporting Requirements*
DOE Order 5500.3A	*Planning and Preparedness for Operational Emergencies*
DOE Order 5700.6C	*Quality Assurance*
DOE Order 5820.2A	*Radioactive Waste Management*
DOE-DP-STD-3005-93	*Evaluation Guidelines for Accident Analysis and Safety Structures, Systems, and Components (Draft)*
DOE-STD-3009-93	*Preparation Guide for U.S. DOE Nonreactor Nuclear Facility Safety Analysis Reports (Draft)*
29 CFR 1910.119	*Process Safety Management of Highly Hazardous Chemicals*
29 CFR 1910.120	*Hazardous Waste Operations and Emergency Response*

1.5 SCOPE OF THE SAFETY BASIS

Preparers and writers of SARs must be aware of the scope of requirements that serve as the safety basis for SARs. Preparers of SARs should become familiar with all DOE orders and federal requirements that define the safety basis of the facility or operation.

Include in the scope of the safety basis not only the traditional safety design basis, but also all other relevant safety bases.

Scope of the safety basis involves three main categories:

1. Traditional safety design basis and safety commitments;
2. Safety envelope; and
3. Performance expectations/commitments.

NOTE: See Chapter 2, Section 2.1.4.2 of this style guide for a more detailed discussion of Scope of the Safety Basis.

1.6 SNL SAFETY ANALYSIS DOCUMENTATION FOCUS

Focus of a PSAR is on design and construction safety.

Before building a new facility, management must prepare a Preliminary SAR (PSAR). It must address the design and construction aspects of facility safety and management's commitments to assure operational safety. Much of the programmatic data and detail required in DOE Order 5480.23 will not be available at the PSAR stage.

A FSAR is derived from the integration of operational and organizational safety with the PSAR.

The PSAR must be upgraded to a Final SAR (FSAR) before the facility becomes operational. Upgrading requires expanding the PSAR content by addressing operational safety issues. Also to be included in the FSAR are the policies, programs, procedures, practices, and controls that will ensure safe facility operations under all normal, abnormal, and emergency modes of operations.

NOTE: Refer to Appendix C at the end of this style guide for information on the differences in requirements between a PSAR and a FSAR.

SARs should promote reviewer understanding of the design and operational safety of a facility.

SARs should promote **understanding** of the issues relevant to the design and operational safety of the SNL nuclear facilities. Preparers and writers of SARs should strive to present all safety issues information in a way that stylistically enhances communication and understanding and that facilitates DOE approval of the SAR.

Modern computer software allows easy creation of high-quality presentations of technical content that enhance rather than detract from reviewer understanding of SAR content.

1.7 GRADED APPROACH

Structure the SAR on a "graded approach" per DOE 5480.23 rather than on an encyclopedic approach, present only relevant data, and cover generic subjects briefly.

Those who prepare information for SARs should keep in mind the *graded approach* concept. This concept is addressed in DOE-STD-1027-92, *Hazard Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.*

According to DOE-STD-1027-92, the level of effort, sophistication of analysis, and thoroughness of documentation should be graded or proportioned commensurate with:

1. The magnitude of the consequences that may be realized from identified hazards;

2. The complexity of the facility and the safety systems relied upon to maintain an acceptable level of risk; and

3. The stage of the facility life cycle.

The graded approach also includes consideration of the following:

- Relative importance to safety, safeguards, and security;
- Programmatic mission of the facility; and
- Any other relevant issues.

1.7.1 Magnitude of Consequences of Identified Hazards

The graded approach selected depends on the magnitude of the consequences of the identified hazards.

Regarding item 1 above, the graded approach means that the greater the potential consequences, the more penetrating, thorough, and well-documented the analysis must be. For facilities involving only modest hazards, analysis may be relatively simple. Then, detailing of all the topics listed in paragraph 8.b.(3) of DOE Order 5480.23 is not necessary. With proper justification, some of these topics may be omitted or reduced in detail from what would be required of a Hazard Category 1 or 2 facility (per the criteria of DOE Order 5480.23).

1.7.2 Complexity of Facilities and Safety Systems

The graded approach to be taken also depends on the complexity of the facility.

Per Item 2 above, examples of **highly complex facilities** include:

- Facilities having many interdependent components or systems, and
- Fluid flow processes having extensive instrumentation and control systems or significant system and component redundancy.

These highly complex facilities require extensive analysis and documentation to address all safety issues.

Examples of **moderately complex facilities** are characterized by such processes as:

- Solids handling activities (machining, assembly, etc.) of simple unit movement from one discrete step to another, and
- Research and development operations involving a variety of simultaneous activities.

Examples of **low-complexity facilities** are:

- Vaults, waste storage tanks, etc. not routinely involving hazardous material processing operations, and
- Laboratories processing only a few simple analyses.

Low-complexity facilities generally require only **minimal** analysis and documentation to adequately address all safety issues.

1.7.3 Stage of Facility Life Cycle

The graded approach to be taken may also stem from the current stage of a facility's life cycle.

Regarding item 3 above, application of the graded approach to account for facility life cycle involves consideration of three kinds of facilities:

1. New facilities;
2. Operational facilities with expected long remaining lifetimes; and

3. Operational facilities with expected near-term end of operations and closure.

In a SAR for a new facility, preparers and writers must address not only design, construction, and operational safety, but also safety issues involving decontamination and decommissioning.

The focus for a facility with a long life cycle is on continuing safety.

In preparing a SAR for an operating facility with an expected long remaining lifetime, writers should focus on continued maintenance of operational safety. A detailed account on the commitments to completed phases of the facility life cycle is not necessary, except where the details are needed to support current and expected safety decisions.

The focus for a short-term facility is on safety during phase-out. For an existing facility where operations will be curtailed in the short term, the SAR must contain at least the minimum information necessary to demonstrate operational safety during the phasing out of operations.

For a permanently shutdown facility, SAR preparers must address the safety of decontamination/decommissioning activities and programs.

NOTE: The graded approach selected per the above guidelines must also consider the relative importance of safeguards, security, and the programmatic mission to the overall safety of the facility.

1.8 GENERAL INSTRUCTIONS FOR WRITING SNL SARs

General instructions are based on becoming familiar with the entire Volume 1 style guide. However, in this Chapter 1 section, preparers and writers of SARs may find helpful the outline suggested for presentation of SAR chapter data. Readers also may find value in the subsection presented on presentation of visual aids (figures, tables, pictures, etc.).

1.8.1 Familiarization with Style Guide

To prepare, write, and publish a SAR properly, become familiar with the information contained in this style guide.

Those assigned to prepare, write, and publish SARs should first become familiar with the general philosophy provided in Chapter 1 of this style guide. Then, consult the specific style information relating to the DOE-required topics addressed in Chapter 2, the publications guidelines provided in Chapter 3, and finally all appendices.

Chapter 2 focuses on stylistic treatment of the topics the DOE requires to be included in SARs.

Chapter 3 provides general publication guidelines for SARs.

Chapter 4 identifies the appendices and their contents included at the end of this Volume 1.

Consult guidance provided in DOE-STD-3009-93 (Draft) for more detailed instructions on required SAR technical content.

Preparers and writers of SARs should keep in mind that this Volume 1 is primarily a style guide rather than a comprehensive guide to the SAR technical content required by DOE. This style guide presents technical content while stressing the **style of presentation** of the technical content. The technical content instructions are extensive, but may not be as detailed as other available guidance such as that provided in DOE-STD-3009-93 (Draft). SAR preparers and writers should consult these documents to ensure effective early planning.

1.8.2 Sequence Outline for Presentation of Data

The outline selected for SAR chapters should be used consistently for each chapter, and it should present the most important data first, and only then the supporting data.

Effective style also requires consistent use of the same format for each chapter in the SAR.

SAR information too often tends to be haphazardly presented. Although the data, results, and conclusions presented may be scientifically sound, an inconsistent format and style of presentation among the SAR topic chapters soon distract the reader.

For example, issues may be presented in one chapter but not in another. Or, objectives and scope may be presented for one DOE-required topic but not for another topic. Presentation of the results (noninterpretative) may be mistakenly presented as conclusions (interpretative).

The format selected should present the most important ideas first (i.e., issues, requirements, objectives, and scope), then present the supporting and summarizing information. In this way, readers will be aimed at the beginning of the SAR toward the writer's desired

direction, and they will be more accepting of important findings, results, and conclusions detailed later in the SAR.

Some readers are interested only in any conclusions presented in the SAR.

Any conclusions to be presented also should be summarized up front. Some readers are interested **only** in the conclusions. These readers dislike searching the entire document to find conclusions presented only at the end. They prefer to see the conclusions at least "summarized" up front, even if they are presented in depth later in the document.

Building SAR chapters in this way is the best format for starting and guiding the reader in the desired direction. This kind of organization makes complex data and results seem more **connected** to the objectives and scope and thus more **logical**. Without it, the reader might not see where the SAR data and results are leading, and any findings and conclusions presented may actually surprise rather than convince the reader.

The generic outline suggested in Figure 1.1 is offered to help overcome shortcomings in chapter development. This suggested generic chapter outline sets the stage for the reader, addresses the most important information first, then presents the supporting information.

Outlines other than the generic outline shown in Figure 1-1 may be used. However, the outline selected should present the most important information first, and it should be applied consistently throughout all chapters of the SAR.

1.8.3 Treatment of Visual Aids

Treatment of visual aids in SARs is very important. Visual information should be designed to "stand alone" independent of the text. How to present visual information is covered in detail in Chapter 3, but some general guidelines are summarized here as follows:

Drawings, figures, and tables should be designed to "stand alone" independent of the SAR text.

- Simplify the drawings and art work by showing only the necessary information.
- Provide a reference number and a title in **bold type** for each visual aid (drawing, figure, table, art work) presented.
- Add an explanatory caption in *italics* after each visual title (as is done in this style guide).

Suggested generic outline for each SAR chapter.

SUGGESTED GENERIC TOPIC OUTLINE FOR SAR CHAPTERS

XX	CHAPTER XX: TOPIC TITLE
XX.1	Topic Issues
XX.2	Applicable Topic Requirements
XX.3	Topic Objectives and Scope
XX.4	Topic Program Description
XX.5	Implementation of Topic Program
XX.6	Topic Interfaces with Other Safety Programs and Activities
XX.7	Summary of Safety-Related Commitments
XX.8	Topic References

Figure 1.1. Suggested Generic Outline for SAR Chapters. *This outline is designed to lead the reader quickly in the desired direction.*

- Reference the visual aids by consecutive numbers, based on each chapter, in the text in the SAR.
- Connect all visual aids presented by providing explanations in the text.

NOTE: Consult *Shipley Associates Style Guide*, Revised Edition, reprinted 1992, for detailed guidance on how to present visual information.

1.8.4 Use of Acronyms

See Glossary of Technical Terms for definitions of acronyms.

Definitions of acronyms (e.g., SNL is the acronym for Sandia National Laboratories) that may be used in SARs are given in the *Glossary of Technical Terms* (see Table of Contents for page number where this glossary may be found).

Generally, adhere to the following guidelines when using acronyms in SARs:

General rules for using acronyms.

- Preferably, use the complete name the first time the subject is mentioned in the text, and follow that with the acronym given in parentheses. Or, the acronym may be noted first, followed by the definition in parentheses.

  NOTE: Be consistent throughout the SAR. Do NOT vary the style for presenting and defining acronyms.

- After presenting and defining the acronym, the acronym alone may be used thereafter.

- Re-identify the acronym when not doing so would lead to confusion or reader delay.

Following are examples of a typical application of the above guidelines:

Example 1 — Present the term then the acronym.

> This section is an overview of Sandia National Laboratories (SNL) noise sources. However, except for noise baseline data collected for the Albuquerque International Airport (AIA), existing data are limited. SNL has not monitored noise onsite to date, but the international airport data may be applicable.

Example 2 — Present the acronym then the term.

> This section is an overview of SNL (Sandia National Laboratories) noise sources. However, except for noise baseline data collected for the AIA (Albuquerque International Airport), existing data are limited. SNL has not monitored noise onsite to date, but the international airport data may be applicable.

1.8.5 Writing Guide

See SAND89-0996.

SARs must be issued as SAND reports, have a SAND number, and be formally reviewed and approved. This process is described in "A

Quick Reference to Preparing and Processing SAND Reports" in SAND89-0996.

CHAPTER 2

CONTENTS OF SNL NUCLEAR FACILITY SAFETY ANALYSIS REPORTS

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CHAPTER 2: CONTENTS OF SNL NUCLEAR FACILITY SAFETY ANALYSIS REPORTS

2.1 INTRODUCTION

Chapter 2 provides guidance to planners, preparers, and writers of SARs at SNL on presenting required SAR technical content in the topic format required by DOE.

This Chapter 2 contains guidance on the preferred presentation style for technical content of SARs. Chapter 2 is designed around the topic format required by DOE for technical content presentation in SARs. Some guidelines presented in this Chapter 2 refer to guidelines given in Chapter 1.

NOTE: Before acting on the guidelines given in this Chapter 2, please study the general introductory guidelines given in Chapter 1.

The style of presentation may be the deciding factor in DOE approval of SARs.

As noted in Chapter 1 of this style guide, the style of presentation reflected in a SAR may be the deciding factor in SAR approval or rejection by DOE. Presentation style can create a good impression, or, if the style is faulty, can convey the impression that data, results, conclusions, or recommendations displayed are questionable and perhaps lack validity. An adverse effect of style may well lead DOE to withhold SAR approval.

Effective application of state-of-the-art style techniques to SARs is an attainable goal and a sure way to encourage DOE approval. Planners, preparers, and writers of SARs at Sandia National Laboratories should therefore become adept in applying the style guidelines suggested throughout this chapter. This information is intended to simplify the DOE review process and facilitate DOE approval of SARs.

2.1.1 Regulatory Basis and Reference Documents

See Chapter 1, Section 1.4 for general guidelines for referencing documents in SARs.

The main documents that establish the basis for nuclear facility SARs are:

- 10 CFR 830.110, *Safety Analysis Reports*

  NOTE: This document is the codified representation of the SAR requirements first mandated by DOE Order 5480.23.

- DOE Order 5480.23, *Nuclear Safety Analysis Reports*
- DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*
- DOE-DP-STD-3005-93, *Evaluation Guidelines for Accident Analysis and Safety Structures, Systems, and Components (Draft)*
- DOE-STD-3009-93, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports (Draft)*

2.1.1.1 Applicable Statutes, Rules, and DOE Orders

See Appendix A.

Appendix A of this style guide contains guidelines to acquaint SAR preparers and writers with the various statutes, rules, and DOE orders that govern the safety basis and operations of DOE nuclear facilities. These documents should be thoroughly researched and their applicability determined for the subject facility or operation.

2.1.1.2 Principal Health and Safety Guidelines

See Appendix B.

Appendix B of this style guide contains guidelines that identify the specific DOE orders and the codes and standards containing the SAR health and safety criteria applicable to the facility or operation.

2.1.1.3 Differences Between PSAR and FSAR Requirements

See Appendix C.

Appendix C of this style guide contains content guidance for PSARs and FSARs.

2.1.1.4 Referencing Documents

See Section 1.4.

Chapter 1, Section 1.4 presents information on how to reference documents in SARs.

2.1.2 SAR Purpose

Primary purpose of a SAR.

The primary purpose of a SAR is: **To document the mission of a DOE facility, operation, or process, the intended conduct of operations, and the safety evaluations performed to determine if the facility, operation, or process can be built, operated, and maintained without undue risk to the health and safety of the public and workers, or impact on the environment.**

The SAR has the following supporting purposes:

Supporting purposes of a SAR.

- To be the principal document that identifies the *significant hazards* and *potential accidents* associated with a facility and its systems, components, equipment, or structures;
- To establish the design and operational means to mitigate the significant hazards and potential accidents; and
- To define the safety basis, document the logic of its derivation, demonstrate adherence to the safety basis, and justify its adequacy.

The SAR must be detailed enough to lead a knowledgeable reader to a conclusion that the facility/operation/process can be built, operated, maintained, and decontaminated and decommissioned with an appropriate degree of safety.

Therefore, the SAR information must be accurate about current operations, up-to-date about the state of the technology, and organized in a format that provides easy access to this information.

Preparers and writers are required to review and update the SAR at least annually (or more frequently), as necessary, to ensure it reflects the current state of the facility, operation, or process.

2.1.3 SNL Objectives

SNL objectives of interest to the SAR writer are the SAR objectives and this style guide's Chapter 2 objectives.

2.1.3.1 SAR Objectives

SARs provide the bases for DOE approval of new facilities and operations, major modifications to existing facilities and operations, and eventual decommissioning of the facilities and operations.

NOTE: Throughout this style guide, the word "facility" refers to a facility, process, or operation.

The objectives of a SAR are as follows:

1. Establish the safety basis of a facility.
2. Document the results of a safety analysis of the design, construction, operation, decontamination, and decommissioning of a facility.
3. Define the performance capabilities of structures, systems, components (SSCs), equipment and personnel.
4. Justify the ability of the SSCs and personnel to perform their intended safety functions under normal, abnormal, accident, and specified failure conditions.
5. Define the bounds for determining the existence of an Unreviewed Safety Question (USQ).
6. Provide the basis for developing and selecting the minimum acceptable limits for operating the facility under normal and specified failure conditions, which are to be established in the facility Technical Safety Requirements (TSRs).
7. Define, through analysis, those SSCs/activities that impact safety.
8. Provide guidance for setting maintenance standards and developing operating procedures for a facility.

SAR objectives are formulated to achieve DOE approval of SARs.

2.1.3.2 Chapter 2 Objectives

The SNL objectives for Chapter 2 of this style guide are designed to meet SAR objectives, and are as follows:

1. Provide specific guidance on the preferred style for presenting technical information required by DOE for SARs.

2. Facilitate the DOE approval process for nuclear facility SARs submitted by SNL.

2.1.4 Scope

Instructions relating to the SAR scope are presented in two parts: Chapter 2 Scope, and Scope of the Safety Basis.

2.1.4.1 Chapter 2 Scope

Keep in mind that although this style guide contains information on required DOE technical content for SARs, it is not meant to be a "complete" guide to content. This style guide calls out required content primarily to illustrate various points about style presentation for SARs.

Chapter 2 scope encompasses all required parts and subjects specified by DOE Order 5480.23 and other primary and secondary safety guidelines (see Section 2.1.1 above and Chapter 1, Section 1.4).

Chapter 2 scope encompasses the following **preliminary introductory material** that must be part of a SAR:

- Cover Page Contents
- Cover Page Style
- Table of Contents
- List of Tables
- List of Figures
- List of Acronyms (or Glossary of Technical Terms)

Chapter 2 scope of this style guide also covers the following DOE-required topics plus any appendices needed to address the safety basis for SARs:

- Executive Summary
- Site Characteristics
- Facility Description and Operations
- Hazard Analysis and Classification of the Facility
- Radioactive and Hazardous Material Waste Management
- Inadvertent Criticality Protection
- Radiation Protection
- Hazardous Material Protection
- Analysis of Normal, Abnormal, and Accident Conditions
- Management, Organization, and Institutional Safety
- Procedures and Training

- Human Factors
- Initial Testing, Inservice Surveillance, and Maintenance
- Derivation of Technical Safety Requirements
- Operational Safety
- Quality Assurance
- Emergency Preparedness
- Provisions for Decontamination and Decommissioning
- Appendices

The above scope covers all the topics DOE requires for SARs. If a topic does not apply to a specific facility, the SAR should state the basis for the nonapplicability.

2.1.4.2 Scope of the Safety Basis

Preparers and writers of SARs must be aware of the scope of requirements that serve as the safety basis for SARs. Preparers of SARs should become familiar with all DOE orders and federal requirements that define the safety basis of the facility or operation.

The scope of the safety basis involves three main categories.

Scope of the safety basis involves three main categories:

- Traditional safety design basis and safety commitments;
- Safety envelope; and
- Performance expectations/commitments.

NOTE: The safety basis scope includes not only the traditional design basis, but also all other relevant safety bases.

2.1.5 Traditional Safety Design Basis and Safety Commitments

The safety basis of the facility/operation encompasses not only the traditional safety design basis, but also the safety commitments deriving from the following seven categories of information:

Safety commitments are derived from seven categories of information.

1. Defined safety objectives;
2. Formal quantitatively defined operational safety requirements and safety performance criteria;
3. Commitments to engineering codes and standards;
4. Equipment qualification requirements;

5. Configuration controls;

6. Bases for and contents of TSRs; and

7. Managerial, institutional, and human factor dimensions of safety assurance, including:

   - Staffing and individual personnel requirements for operating crews;
   - Commitments to maintain written procedures and training for operations and maintenance tasks subject to validation and verification requirements;
   - Quality assurance;
   - Emergency planning;
   - Operating experience evaluation and feedback; and
   - Independent oversight.

2.1.6 Safety Envelope

The safety envelope relates to design and operational commitments and encompasses a design envelope and an operational envelope.

The safety envelope encompasses a *design envelope* and an *operating envelope.*

The design envelope is the set of design commitments developed to support the facility as it is configured and operated. The SAR establishes the design envelope that includes:

- Commitments to design codes;
- Facility and site parameters;
- Accident analysis assumptions that determine performance criteria for structures, systems, and components important to safety; and
- Facility and equipment drawings.

The operating envelope is the set of limits or bounds within which all operations must be conducted. Technical Safety Requirements are the principle elements that define the operating envelope. These elements include safety limits, authorized operating conditions, and

administrative controls such as material inventory limits and minimum facility staffing and training.

Preparers and writers of SARs must not only provide safety envelope information about such design commitments, but must present it in appropriate ways. Use of good style in information presentation is essential. Otherwise, engineering, procurement, operations, and maintenance personnel may not be able to see clearly what tasks they must perform to maintain these commitments or what changes they must invoke if an alternate safety commitment is contemplated.

2.1.7 Performance Expectations

The safety analysis process uses design and operational performance "expectations" intended to assure facility safety.

The safety analysis process uses design and operational performance "expectations" that assure facility safety such as:

- Assumed conditions associated with accident analyses;
- Methods and bases for compliance with generic statutes, federal rules, DOE directives, and cited national codes and standards; and
- Details of institutional safety programs.

"Expectations" that are essential to the **validity** of a safety analysis, by necessity, become "commitments" whose realization must be assured. The information included in the SAR must be adequate to ensure that personnel can **understand** what must be done to maintain such commitments and what **changes** are required, if an alternate safety commitment is contemplated. Safety commitments should be summarized at the end of each SAR chapter in which the commitments are first established. This process facilitates development of technical safety requirements for the facility.

2.1.8 Graded Approach

Base SAR preparation on a "graded approach" per DOE-STD-1027-92 rather than an encyclopedic approach.

Those responsible for preparing information for inclusion in SARs should keep in mind the *graded approach* concept. This concept is addressed in DOE-STD-1027-92, *Hazard Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*.

According to DOE-STD-1027-92, the level of effort, sophistication of analysis, and thoroughness of documentation should be graded or proportioned commensurate with:

Also, present only relevant data and cover generic subjects briefly.

1. The magnitude of the consequences that may be realized from identified hazards;
2. The complexity of the facility and the safety systems relied upon to maintain an acceptable level of risk;
3. The stage of the facility life cycle;
4. The relative importance to safety, safeguards, and security; and
5. The programmatic mission of the facility.

NOTE: See Chapter 1, Section 1.7 for a compete discussion of the graded approach to writing SARs.

2.1.9 Facility Safety Programs and Activities

SNL nuclear facilities management typically establishes various activities and programs to ensure protection for the public, the environment, and facility workers. Many are also established to comply with other requirements of DOE orders.

Together, these activities and programs represent an assessment of the interfacing of all factors that provide assurance of safe facility operations. However, to enhance and convey the **validity** of this assurance, 11 of the topics required to be addressed in SARs must be discussed in sufficient detail to convince the reader that nuclear facility management is both appropriate and effective in controlling identified facility hazards. The 11 topics are:

Eleven SAR topics must be addressed in sufficient detail to establish that facility operations are safe.

1. Radioactive and Hazardous Material Waste Management;
2. Inadvertent Criticality Protection;
3. Radiation Protection;
4. Hazardous Material Protection;
5. Management, Organization, and Institutional Safety Provisions;
6. Procedures and Training;

7. Human Factors;

8. Initial Testing, Inservice Surveillance, and Maintenance;

9. Operational Safety/Conduct of Operations;

10. Quality Assurance; and

11. Emergency Preparedness.

Presentation style for these topics is especially important. They should be described using the generic outline (or one equally effective) shown in Chapter 1, Section 1.8.2, Figure 1.1. This generic outline presents SAR information in such a way that the most important information (from the reader's point of view) is presented first, then the supporting information.

Reference documentation supporting the 11 topics when possible.

Existing documentation supporting these 11 topics should be referenced when possible. Then, the presentation of information should consist of brief abstracts of the referenced documentation. These abstracts should be supported by enough salient facts to ensure adequate understanding of the topic and its relation to the facility's safety basis.

Also, where the same or similar topic discussions are requested in more than one place in the SAR, referencing the once-provided material is appropriate, rather than repeating it in full. New material should be provided only as needed.

2.2 COVER PAGE

Treatment of the SAR cover page can best be understood in terms of cover page contents and cover page style.

2.2.1 Cover Page Contents

On the following page, Figure 2.1 shows an example of a cover page for a SAR. This example shows the elements that must be included on a SAR cover page.

The SAR cover page must contain specific information.

The SAR cover page must include the following:

- Report number, type, distribution, and category of report (e.g., SAND47-6789, Unlimited Release, etc.);

This figure shows all the elements of information required for cover pages of SARs.

SAND47-6789
Unlimited Release

Distribution
Category UC-FY1

LUNAR SPACE STATION
POWER REACTOR TEST FACILITY
SAFETY ANALYSIS REPORT

Sandia National Laboratories
Albuquerque, New Mexico

January 1947

Prepared Under
Sandia Contract No. ZZ-1234

Abstract

The Lunar Space Station Power Reactor Test Facility is intended to demonstrate adequate safety for the earth launching and lunar landing of the nuclear power module selected for the Lunar Community Feasibility Experiment. This will be accomplished by means of a series of simulated and one-fifth scale tests to benchmark the results of the launch and landing safety analyses that have been performed for this module. This Safety analysis Report provides the safety basis for the facility that has been constructed to perform the benchmarking tests.

Figure 2.1. Example of Cover Page for a SAR. *The cover page contains all the required identifying elements plus an abstract.*

- Title of the facility or operation (e.g., Lunar Space Station Power Reactor Test Facility);
- The particular type of safety documentation (e.g., Safety Analysis Report);
- Responsible organization (e.g., Sandia National Laboratories, Albuquerque, NM);
- Date of issue that includes the month and year (e.g., January 1947);
- SNL contract number authorizing the report if applicable (e.g, Sandia Contract No. ZZ-1234); and
- Brief abstract at bottom of page.

2.2.2 Cover Page Style

Cover page style should meet the following criteria:

- Type font used on the cover page should be *sans-serif.*

The cover page must adhere to specific style criteria.

- Type font size for the title should be 16-point.
- Type font size for other information on the title page should be less than 16-point.
- Information contained on the cover page should be well-balanced and fall within the page border limits of 1-1/2-inch left and right margins and 1-inch top and bottom margins.

2.3 TABLE OF CONTENTS

On the following page, Figure 2.2 shows an example of a Table of Contents for a SAR. This figure illustrates the style prescribed for a Table of Contents for a SAR.

The Table of Contents should adhere to specific style guidelines.

The Table of Contents for a SAR should adhere to the following style criteria:

- The title heading should be in all bold capital letters and in 14-point or larger *sans-serif* type, such as 14- or 16-point Arial (e.g., **TABLE OF CONTENTS).**

A Table of Contents for a SAR should follow specific style criteria illustrated in this example of a typical page from a SAR.

TABLE OF CONTENTS

Figure 2.2. Example of a Table of Contents Page for a SAR. *The example illustrates the style criteria specified for SARs at Sandia National Laboratories.*

- The remainder of the Table of Contents should be presented in less than 14-point *serif* type (e.g., 12-point New Times Roman).

- The Section and Page column headings should begin with an initial capital letter, and the headings should be in bold and underlined (i.e., **Section Page**).

- Sections of the SAR designated on the Table of Contents should be numbered using the decimal system, with successive decimal points indicating levels of subordination.

- A two-digit-level section (i.e., X.0 and X.X) titles should be in capital letters in a *serif* font (e.g, New Times Roman).

- A three- and four-digit level subsection heading should have only the **first** letter of the first word, first letter of all main words, and the first letter of the last word of the heading capitalized.

- Spacing between a two-digit **X.0** lead section heading and its two-digit **X.X** major section headings should be single spacing.

- Spacing between a series of two-digit **X.X** major section headings should be single spacing.

- Spacing between a two-digit **X.X** major heading and a three-digit **X.X.X** subsection or a series of three-digit **X.X.X** subheadings should be single spacing.

- Spacing between a three-digit **X.X.X** subheading and the next two-digit **X.0** lead section heading should be double spacing.

- Page numbers assigned to the Table of Contents should be centered at the bottom of the page and be in small Roman numerals (ii, iii, iv, etc.).

2.4 LIST OF TABLES

On the following page, Figure 2.3 shows an example of a List of Tables for a SAR. This figure illustrates the prescribed style for a SAR List of Tables.

A List of Tables for a SAR should adhere to the following style criteria:

- The List of Tables heading should be in all bold capital letters and in 14-point or larger *sans-serif* type, such as 14-point Arial (e.g., **LIST OF TABLES**).
- The remainder of the List of Tables should be presented in less than 14-point *serif* type (e.g., 12-point New Times Roman).
- The information in the List of Tables should be presented in three columns: Table No., Title, and Page.
- The table column headings should begin with an initial capital letter, and the headings should be in bold and underlined (i.e., **Table No.** **Title** **Page**).
- Table numbers should be identified using decimal numbers, and they should be numbered separately within each chapter (e.g., the third table in chapter 3.0 of a SAR would be Table 3.3).
- Table titles should have only the first letter of the first word, first letter of all main words, and the first letter of the last word capitalized (e.g., Table 3.3 Meteorological Data: Albuquerque, NM Average Temperature).
- Spacing between a series of table titles for a specific chapter should be single spacing, and two spaces should be inserted between the tables of one chapter series and those of another chapter series.
- The page number should be centered at the bottom of the page and should be in small Roman numerals (iii, iv, etc.).

A List of Tables for a SAR should follow specific style criteria illustrated in this example.

LIST OF TABLES

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Figure 2.3. Example of a List of Tables for a SAR. *The example illustrates the style criteria specified for SARs at Sandia National Laboratories.*

2.5 LIST OF FIGURES

On the following page, Figure 2.4 shows an example of a List of Figures for a SAR. This figure illustrates the prescribed style for a SAR List of Figures.

A List of Figures for a SAR should adhere to the following style criteria:

- The List of Figures heading should be in all bold capital letters and in 14-point or larger *sans-serif* type, such as 14-point Arial (e.g., **LIST OF FIGURES**).
- The remainder of the List of Figures should be presented in less than 14-point *serif* type (e.g., 12-point New Times Roman).
- The information in the List of Figures should be presented in three columns: Figure No., Title, and Page.
- The column headings should begin with an initial capital letter, and the headings should be in bold and underlined (i.e., **Figure No.** **Title** **Page**).
- Figure numbers should be identified using decimal numbers, and they should be numbered separately for each chapter (e.g., the third figure in Chapter 3.0 of a SAR would be Figure 3.3).
- Figure titles should have only the first letter of the first word, first letter of all main words, and the first letter of the last word capitalized (e.g., Figure 3.3 Curve Showing Meteorological Data: Albuquerque, NM Average Temperature).
- Spacing between a series of figure titles for a specific chapter should be single spacing, and two spaces should be inserted between the figures of one chapter series and those of another chapter series.
- The page number should be centered at the bottom of the page and be in small Roman numerals (viii, ix, etc.).

A List of Figures for a SAR must contain not only specific information but should adhere to specific style guidelines.

A List of Figures for a SAR should adhere to specific style criteria illustrated in this example.

LIST OF FIGURES

Figure 2.4. Example of a List of Figures for a SAR. *The example illustrates the style criteria specified for SARs at Sandia National Laboratories.*

2.6 LIST OF ACRONYMS

Preparers and writers of SARs should include a list of all acronyms used in the SAR only if a *Glossary of Technical Terms* is not to be provided. Otherwise, the acronyms should be included in the glossary.

*Avoid redundancy in the SAR — provide either a **List of Acronyms** or a **Glossary of Technical Terms**, but not both.*

For example, see the *Glossary of Technical Terms* on introductory page xvii of this Volume 1 style guide. This glossary contains the acronyms and definitions of the acronyms as well as definitions of other terms used in this style guide. Consequently, a List of Acronyms for Volume 1 is not provided in order to avoid redundancy.

A formal List of Acronyms provided in a SAR should adhere to the following style criteria:

General points of style for presenting a List of Acronyms.

- The List of Acronyms heading should be in all bold capital letters and in 14-point or larger *sans-serif* type, such as 14-point Arial (e.g., **LIST OF ACRONYMS**).
- The remainder of the list should be presented in less than 14-point serif type (e.g., 12-point New Times Roman).
- The list should be presented in two columns with the acronym placed in the first column and the words defining the acronym placed in the second column.
- The words which the acronym is an abbreviation should have the first letter of the first word, first letter of all main words, and the first letter of the last word capitalized.
- The page number should be centered at the bottom of the page and should be in small Roman numerals (vii, ix, etc.).

NOTE: See Chapter 1, Section 1.8.4 for general guidelines and examples of how to use acronyms in SARs.

2.7 EXECUTIVE SUMMARY

2.7.1 Objectives

The Executive Summary should have:

The writer's main objective for the Executive Summary is to provide top-echelon decision makers with a synopsis of the SAR.

The Executive Summary is the first major portion of a SAR. It is a DOE-required part of a SAR. This kind of summary should be written specifically for the top echelon of Department of Energy staff who will have the final responsibility and authority to approve or reject the SAR.

A "stand alone" quality;

Ideally, the Executive Summary should be designed to "stand alone." It should not only convey data but also the specific essence, issues, and messages contained in the complete SAR.

The Executive Summary must not conflict with the information presented in the SAR, and it must not present items not discussed in the body of the report.

2.7.2 Scope

A scope based on a structure that presents the most important, then the supporting information.

The Executive Summary should contain specific information. The most important information should be first, and then the supporting information. The following is suggested as an outline for **summarizing** the required information for top-echelon DOE staff:

1. Chapter Number and Title
2. Introduction
3. Summary SAR Conclusions (interpretative)
4. SAR Issues
5. SAR Objectives
6. SAR Scope
7. Facility Overview
8. Facility Background
9. Summary of Major Safety Analysis Results (noninterpretative)
10. Detailed Conclusions (interpretative)
11. SAR Content Guide

2.7.3 Introduction

The Introduction sets the stage; it does not present details.

The introductory section must "set the stage" and start the reader in the desired direction. It should not contain details. Details come later in the summary (the reader may choose not to read them).

The following are suggested as a method to initiate the reader to the SAR:

- Briefly identify the SNL facility involved.
- Briefly identify the main criteria on which the SAR is based, especially:
  - 10 CFR 830.110
  - DOE Order 5480.23
  - DOE-STD-1027-92

Preparers and writers of SARs can make use of several methods designed to introduce a reader to the SAR document.

- Identify the architect-engineer and the prime contractors for design, construction, and facility operation.
- Identify the stage or stages of the facility life cycle for which the SAR has been prepared and for which DOE authorization is sought.
- Briefly state the safety analysis objectives and scope.
- Briefly state that the summary provides information on critical issues as well as a brief overview and history of the facility.
- Briefly state that a discussion of SAR requirements is provided.
- Briefly state that the conclusions are interpreted and summarized, and that they are based on reliable scientific results.

2.7.4 Summary of SAR Conclusions

"Set the stage" for the reader early.

"Set the stage" for the reader early. Begin the Executive Summary with a synopsis of the detailed conclusions and recommendations (if any) given at the end of the Executive Summary. For the reader's sake (e.g., a DOE decision maker), crystalize these detailed conclusions/recommendations up front. Some readers seek only this

synopsis and will not read through the Executive Summary to find supporting information or the conclusions placed only at the end.

NOTE: Keep in mind that conclusions are NOT results. Results give facts. Conclusions interpret results.

2.7.5 SAR Objectives

With the conclusions presented up front, tell the reader what the objectives of the SAR are. Offer clear, concise statements.

2.7.6 SAR Scope

Relate the scope to the objectives.

State the scope of the safety analysis so the reader will understand the limits of the SAR safety analysis. Mention that the scope is based on the above objectives.

2.7.7 Facility Overview

Avoid a too extensive facility overview and background.

Be brief in this overview. Present just enough information to portray a mental image of the facilities involved in the safety analysis.

2.7.8 Facility Background

Also be brief in presenting a history of the facility, and relate it to the issues involved and the safety analysis to resolve the issues.

2.7.9 Summary of Major Safety Analysis Results

Summarize only the major safety analysis results and do not present detailed data.

The section should summarize:

- Potential hazards addressed;
- Design basis accident (DBA) and risk-dominant accident scenarios analyzed;
- Measures taken to eliminate, control, or mitigate the consequences of accidents; and
- Normal Operations, Abnormal Conditions, and Accidents.

Figure 2.5 on the following page shows an example from a SAR describing actual normal operations, anticipated abnormal conditions, and potential accidents in a nuclear facility.

NOTE: Remember, summarize only. Do not present details and arrays of data in an Executive Summary.

2.7.10 SAR Content Guide

Give only a skeleton SAR content guide for reader reference.

In this section outline the general content of the SAR. For example, say that the SAR presents all relevant general and specific information the DOE requires for a SAR. Note that the SAR specifically addresses all topics required by DOE regulations. Figure 2.6 shows an example from a Preliminary SAR (or PSAR) discussion of the contents.

2.7.11 Detailed SAR Conclusions

List the detailed conclusions and if appropriate make recommendations.

This section should complete the required portions of an Executive Summary. Include in this section direct statements of the main conclusions relating to the issues, objectives, and scope already discussed in the front part of the summary. Then, interpret for the reader the meaning of the conclusions in terms of nuclear facility and/or process safety.

If recommendations are appropriate, make them in this section.

2.8 SITE CHARACTERISTICS

2.8.1 Objectives

The writer's objective for this SAR topic is to describe all aspects of the SNL site.

2.8.2 Scope

The scope of information that writers should use to characterize the facility site include:

The scope of this information must cover site location characteristics, site hazard characteristics, and onsite and offsite population characteristics.

For Hazard Category 3 facilities, this discussion scope should focus within the site boundaries. Discussions of subjects such as

Example from a PSAR showing an actual write-up describing normal operations, anticipated abnormal conditions, and potential accidents in a nuclear facility.

2.7 Summary of Normal Operation, Abnormal Conditions, and Accidents

The new Gamma Irradiation Facility (GIF) incorporates the sources and test facilities from two existing SNL irradiation facilities: the current GIF in TA-V (operating since 1962) and the Low Intensity Cobalt Array (LICA) Facility in TA-1 (operating since 1982). Experience from these 42 years of safe operation of these facilities is the foundation for determining/analyzing the new GIF design and planned operations. Anticipated conditions are determined for normal and abnormal operations of the GIF, along with the expected consequences from accidents.

For the accident analysis, the "graded approach" specified in DOE Order 5480.23 is used to identify the analysis and documentation requirements for accidents.[5] The GIF has a Category 3 Hazard classification; thus, the analysis is a qualitative assessment of the overall risk. Based on guidance from DOE-STD-1027, a methodology for performing a qualitative assessment was developed.[6] This methodology is similar to a problematic risk assessment in which the probability of an accident sequence and the unmitigated consequences are postulated. Based on these elements, the methodology identifies the minimum number and type of safety-related features required to assure that the overall risk is low for each anticipated accident sequence.

Postulated accidents cover natural phenomena, operational accidents, and factors external to the GIF. The matrix of accidents contains 12 categories. A total of 37 sequences were analyzed that were initiated by 50 separate causes. This matrix is the basis for identifying the 5 safety-related systems (i.e., the engineered safety features) necessary for safe operation of the facility. These systems, along with their primary safety functions and type of function, are shown in Table 1-1 below. Only one system (source cladding) provides the containment function that prevents dispersal of the radioactive material. Other safety-related systems mainly prevent inadvertent radiation exposure of the GIF facility personnel. Consistent with the GIF's Hazard Category 3 classification, no safety-related system is required to protect other site workers, the public, or the environment.

Table 1-1. Safety-Related Systems for the GIF

Engineered Safety Features	Primary Safety Function	Type of Function
1. Source cladding	Containment of radioactive material	Passive
2. Water pool	Radiation shielding	Passive
3. Irradiation cell shield	Radiation shielding	Passive
4. Elevator poser interrupt	Access control	Active
5. Radiation monitoring system	Detection of radiation conditions	Active

1-7

Figure 2.5. Example from a PSAR Showing a Summary of Normal Operations, Abnormal Conditions, and Accidents. *This PSAR example stresses the "anticipated" abnormal conditions and the types of "potential" accidents that the facility possibly could experience.*

Example from a PSAR showing its required content compared with a FSAR.

1.8 Guide to SAR

This Preliminary SAR (PSAR) is being written to comply with DOE Order 5480.23. The requirements for analysis, documentation, and content for a PSAR were adopted from this order. The order introduces the concept of "graded approach" to applying SAR requirements for analysis and documentation commensurate with the following three considerations: (1) magnitude of hazards addressed, (2) complexity of the facility and safety systems, and (3) state of the facility life cycle. As noted in the order, the "preliminary" stage of a facility in design warrants a less detailed safety analysis process: DOE Order 5480.23 is not explicit in required content for a PSAR. Therefore, explicit PSAR requirements are adopted from the superseded DOE/AL Order 5481.1B and applied to the new format specified in Order 5480.23. Based on DOE/AL Order 5481.1B, the topics/chapters to be addressed in a PSAR are the following:

1) Introduction
2) Summary/Conclusion
3) Site Description and Assessment
4) Description of Facility
5) Description of Operations
6) System Risk Analysis
7) Accident Analysis

Table 1-1 lists the chapters/topics in the PSAR. For each topic, the terms "complete" and "preliminary" designate the amount of detail presented. For any section, "complete" implies that analysis, design, and specification are complete and documentation presented in the PSAR is as detailed as possible at this point in the design process. "Preliminary" implies that only an overview of this topic is presented and some changes in the content are expected before the final version of the SAR (FSAR).

Table 1-1. Chapter/Topic and Section Detail for the GIF PSAR

Chapter	Title	Corresponding DOE 5481.1B Chapter	Level of Detail
1	Executive Summary	1/2	Complete
2	Applicable Statutes, Rules, and Orders	4	Complete
3	Site characteristics	3	Complete
4	Description of Facility and Operations	4/5	Complete
5	Hazard Analysis and Facility Classification	5	Complete
6	Principal Health and Safety Criteria	4	Complete
7	Waste Management	10	Preliminary
8	Inadvertent Criticality Protection	11	Not Applicable
9	Radiation Protection	10/11	Preliminary
10	Hazardous Material Protection	10/11	Preliminary
11	Analysis of Normal, Abnormal and Accident Conditions	5/6/7	Complete
12	Management, Organization, and Institutional Safety Provisions	9/10	Complete
13	Procedures and Training	16	Preliminary
14	Human Factors	None	Preliminary
15	Initial Testing, Inservice Surveillance, and Maintenance	9	Preliminary
16	Derivation of TSR Requirements	8	Preliminary
17	Conduct of Operations	17	Preliminary
18	Quality Assurance	9	Preliminary
19	Emergency Preparedness	15	Preliminary
20	Facility D&D	14	Preliminary

1-9

Figure 2.6. Example of a Guide to PSAR Content. *As the example shows, a PSAR must cover a limited scope of relevant topics, while a complete SAR (or FSAR) must address all of the DOE-required topics.*

meteorological conditions, hydrology, and offsite population are not required, because unmitigated accident consequences are, by definition, limited to the facility itself.

2.8.3 Site Location

Site location characteristics;

In describing the characteristics of the site location, the SAR must include all essential information relevant to SNL site location. The writer must state which of the following are being described in the SAR facility description:

1. A site already selected by DOE (reference the applicable NEPA document number);

2. An operating site being supported by the safety analysis for DOE review and approval; or

3. A proposed envelope of acceptable site characteristics derived from a safety analysis.

Except for the third type of site noted above, the site description should include the following items:

- Site Location—specifically the state and county where the site is located;

- Site Location Relative to Prominent Natural or Manmade Features—especially:

  - Rivers and lakes
  - Population centers and public receptor sites
  - Other DOE facilities
  - Local and regional highways, railroads, and airports
  - Electrical transmission lines and natural gas pipelines
  - Oil and natural gas storage facilities
  - Local industrial facilities;

- Site Maps—Suitably scaled and that:

  - Show the site relative to regional terrain features, nearby facilities, residences, population centers, and other public sector sites, and

  - Define the site boundary and distances from significant site structures to the boundary, including potential effluent release points; and

- Definitions of facility exclusion areas and the site boundary—especially with respect to public exclusion areas, access control areas, and property lines.

2.8.4 Site Hazard Characteristics

Site hazard characteristics;

The information the writer presents here should characterize the site sufficiently to support input parameters required for modeling dispersion of radionuclides and other hazardous materials into the environment. This information must include:

- Demography;
- Local and regional meteorology, climatology, land and water use patterns, surface and subsurface hydrology, geology, and seismology; and
- Any other unique features of the site relevant to the safety analysis.

2.8.5 Onsite and Offsite Population Characteristics

Onsite and offsite characteristics of the population affected.

The site characterization should also consider:

- Population sheltering or shielding parameters;
- General public and worker evacuation rates and delay times; and
- Characteristics of other facilities and properties possibly at risk from accidents at the SNL facility being analyzed.

On the following page, Figure 2.7 shows an example page from a site characteristics topic write-up from a SAR. The example shows how site characteristics have been addressed in the past. The example is shown to illustrate the **kinds of information** that should be presented for this SAR topic.

Example of a page from a SAR showing the kinds of data the writer typically presents for the site characteristics topic.

3.0 SITE CHARACTERISTICS

3.1 DESCRIPTION OF THE SITE AND BOUNDARIES

Sandia National Laboratories/New Mexico (Sandia/NM) is located approximately 10 kilometers (6 miles) east of downtown Albuquerque, NM, in the foothills of the Manzano Mountains (see Figure 1.1-1 and 1.1-2). Sandia/NM is surrounded by Kirtland Air Force Base (KAFB) and has co-use agreements on portions of Air Force property. KAFB is located on two broad mesa that are bisected by the Tijeras Arroyo, an east-west trending canyon. These mesas are bounded by the Sandia and Manzano Mountains (Cibola National Forest) to the east and the Rio Grande River to the west.

Regional elevations range from 1,500 meters(4,922 feet) at the Rio Grande to 3,255 meters (10,680 feet) at Sandia Crest. KAFB is at a mean elevation of 1,630 meters (5,348 feet).

Sandia/NM is operated for the Department of Energy (DOE). Sandia/NM has five technical areas (TAs) and remote test areas situated in the eastern half of the 74-square-mile KAFB military reservation (see Figure 1.1-3). Adjacent to and combined with KAFB is the Albuquerque International Airport. Together these constitute a large military-commercial transportation complex. Landing/takeoff runway patterns at the airport are not expected to affect Sandia/NM operations. The runway of most concern is the east-west runway.

The Annular Core Research Reactor (ACRR) is an integral part of the Sandia National Laboratories (SNL) Technical Area V (TA-V) complex. This complex consists of:

- The ACRR
- The Sandia Pulsed Reactors
- The Gamma Irradiation Facility
- The Hot Cell Facility
- Various laboratories and support shops.

TA-V is located 5,400 meters south of SNL Technical Area (TA-I), and 4,000 meters south of Technical Area IV (TA-IV). These two areas contain the largest concentration of personnel and equipment within SNL.

The Exclusion Area for TA-V is defined as that region bounded by a circle of 3,000 meters radius centered at TA-V. This definition places all of the Exclusion Area within the direct control of KAFB (i.e., either the U.S. Air Force or SNL), and therefore satisfies the Code of Federal Regulations, Title 10, Part 100 criteria.

3.2 WEATHER AND CLIMATE

Sandia/NM temperatures are characteristic of high-altitude, dry, continental climates. Sunshine is a predominant feature of Sandia/NM and occurs approximately 75 percent of daylight hours. Maximum daytime temperatures during the winter of 1988 averaged near 10 °C (50 °F). Summer daytime maximum temperatures averaged less than 32 °C (90 °F), except in July when the maximum average reached 34 °C (93 °F) [NOAA, 1988]. Temperature extremes below -27 °C (-17 °F) or above 41 °C (105 °F) occur infrequently [MHE, 1991].

The average annual precipitation for Sandia/NM is 21 centimeters (8.3 inches); half of .....

3-1

Figure 2.7. Example Page from a SAR Showing Typical Site Characterization Information Required by DOE. *The information shown is typical of SARs, and the style in which the information is presented is generally compatible with this style guide.*

2.9 FACILITY DESCRIPTION AND OPERATIONS

2.9.1 Objectives

The writer's objective for this topic discussion in the SAR is to describe the subject facility safety analysis and the principal equipment and processes provided to fulfill the facility's mission.

2.9.2 Scope

Preparers and writers of SARs should provide descriptions of all facility components sufficiently to support the safety analysis process.

The scope of this topic should include descriptions of the following:

1. Safety-Class and Safety-Significant Structures, Systems, Components, Equipment, and Processes;
2. Safety-Class and Safety-Significant Support Systems; and
3. Plans, Provisions, and Requirements for Operation, Maintenance, and Surveillance of Safety-Class and Safety-Significant Systems.

Figure 2.8 shows an example of a page extracted from a SAR. This example page illustrates the **kinds of information** that should be developed for this topic presentation.

2.9.3 Description of the Facility

Describe the facility in depth, but based on the graded approach.

Writers should describe the general facility characteristics of structures, systems, components, equipment, and processes in sufficient detail (based on the graded approach described in Chapter 1) to support identification of:

- Hazards;
- Principal safety criteria;
- Designation of engineered safety features (ESF); and
- Analysis of accidents.

Example of a page from a SAR showing the kinds of information typically presented to describe the facility operations.

4.0 FACILITY DESCRIPTION AND OPERATIONS

4.1 General Facility Characteristics

The ACRR facility is in the part of Building 6588 referred to as the High Bay (Room 10). This building is part of a larger complex including two other major structures: Buildings 6580 and 6581. Major uses of these two buildings are for laboratories, maintenance, building utilities, and offices. Building 6588 comprises the High Bay, Low Bay, ACRR control room, utilities, several small labs, a computer complex, and numerous offices. The High Bay is separated from the other spaces by one common, continuous, concrete block wall that forms one side of the High Bay. High Bay ingress/egress is through several personnel and equipment doorways that can be locked by the Reactor Staff to control access into the High Bay. The personnel door normally used for the High Bay opens into a vestibule and passageway leading directly into the common hallway for Building 6588; another passageway from that vestibule exits to the outside. Other personnel doors permit access (1) into an equipment room containing various water control and hydraulic pump equipment and an exit to the outside, and (2) into the Low Bay in which there are direct exits to the outside. A standard large motor-driven metal door located in the west wall of the High Bay provides access for equipment.

The High Bay ventilation system consists of three distinct systems: a supply system, an exhaust system, and a cavity purge system. The supply system and exhaust system air flows are maintained at rates monitored by pressure gauges in the ACRR control room to assure that the High Bay (reactor room) is maintained at a pressure differential that is negative with respect to all other adjoining spaces and the outside environment. Also, the cavity purge system is designed to draw air through an experiment facility, such as the control cavity, and to maintain the pressure differential to assure air flow from the reactor room through the experiment cavity. The cavity purge system prevents accumulation of radioactive gases in the experiment facilities connected to the manifold. Air drawn through the purge system is filtered by a bank of HEPA (high efficiency particulate air) and charcoal filters. Air extracted by the High Bay exhaust system is filtered only during emergency operations.

The Low Bay and the ACRR control room are self-contained rooms adjacent to the High Bay. Control room personnel can observe all reactor operations and activities in the High Bay through a window in the common wall. Control room and Low Bay ventilation systems, including air conditioning, are totally separate from the High Bay ventilation system.

4-1

Figure 2.8. Example SAR Page Presenting Typical Facility Characteristics Information. *This example illustrates the kinds of facility characteristics information typically presented in a SAR.*

2.9.3.1 Safety-Class and Safety-Significant Structures, Systems, Components, Equipment, and Processes

Focus information on safety-class and safety-significant features relating to:

Structures, systems, components, equipment, and processes;

Begin this section with a list of the **safety-class** and **safety-significant** structures, systems, components, equipment, and processes included in this section of the SAR. The description should contain details of:

- Structures and containers holding radioactive materials or hazardous materials, and
- Process systems, including information on design configuration, dimensions, construction materials, pressure and temperature limits, corrosion allowances, and any other operating limits.

System descriptions should include current general system and process information drawings. These should contain enough detail to let qualified reviewers verify conformance with safety design bases, codes, standards, and commitments. Use simple system drawings and flow diagrams rather than detailed piping and instrumentation drawings (P&IDs) and engineering drawings. P&IDs can be referenced in either the simplified drawings or in the system descriptions.

> **NOTE: Hazard Category 3 facilities do not have safety-class structures, systems, and components (SSCs). They have only safety-significant SSCs that contribute to worker safety.**

On the following two pages, Figures 2.9 and 2.10 show examples of drawings extracted from a SAR. These examples show the typical kinds of information that can be portrayed in visual aids for this topic.

2.9.3.2 Safety-Class and Safety-Significant Support Systems

Mechanical, electrical, and fluid support systems.

Descriptions of **safety-class** and **safety-significant** support systems (including mechanical, electrical, and fluid systems) should address system function, design basis, and relevant design features.

Process/operational support systems, including instrumentation/control systems, should also be described. Especially describe those necessary for the proper performance of **engineered safety features (ESFs)**.

Example figure from a SAR showing typical facility system information.

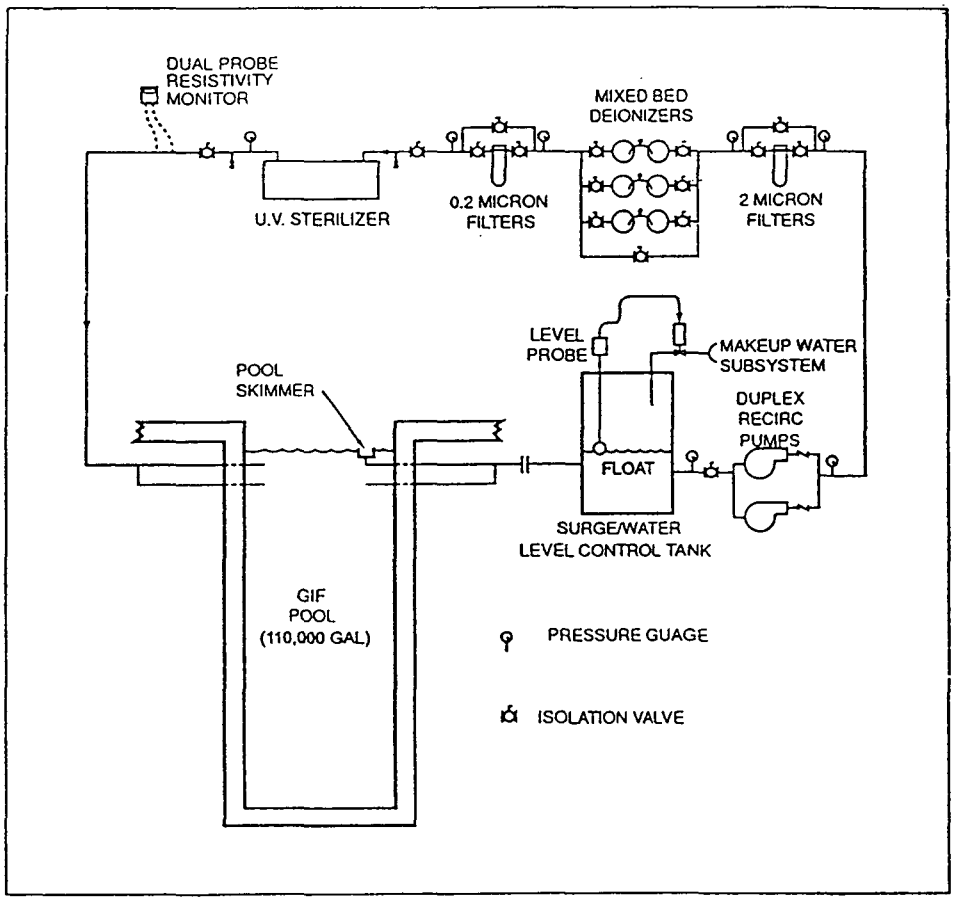


Figure 4.4 GIF Pool Water Recirculation Loop

4-3

Figure 2.9. Example Figure from a SAR Showing Typical Process System Information. *The artwork presented should enhance, not complicate, the reader's understanding.*

Example figure from a SAR showing typical facility system information.

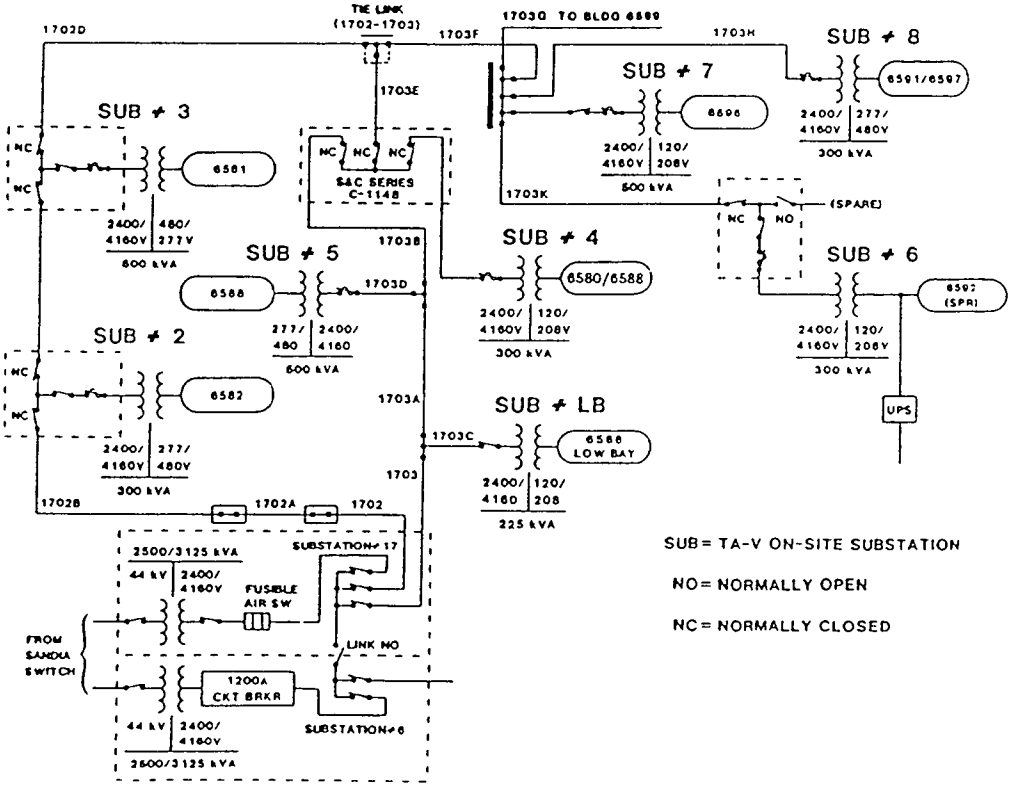


Figure 4.8 Technical Area V (TA-V) Power Distribution

4-4

Figure 2.10. Example Figure from a SAR Showing Typical System Information. *The artwork presented should enhance, not complicate, the reader's understanding of the process involved.*

Figure 2.11 on the following page shows an example page from a SAR that addresses ESFs. This example page illustrates the kinds of information SARs should contain in describing ESFs.

Writers should include information on ESFs that addresses:

- ESF function as it relates to safety;
- Sets of conditions under which ESFs must function;
- Interfaces with other safety systems;
- Any dependencies on auxiliary or ancillary systems, including associated operational uncertainties for such systems under accident conditions;
- Summary of ESF performance criteria; and
- Summary of design basis accidents (DBAs) and other accident scenarios that were used to determine the accident conditions and performance criteria.

SAR writers must ensure that all information prescribed in this style guide for this DOE-required topic is adequate to evaluate impacts on design and configuration commitments.

2.9.4 Plans, Provisions, and Requirements for Operation, Maintenance, and Surveillance of Safety-Class and Safety-Significant Systems

In presenting this topic in the SAR, writers must also include descriptions or summaries of the plans, provisions, and requirements for operation, maintenance, and surveillance of safety-class and safety-significant systems.

NOTE: All descriptions and summaries prescribed above should contain enough detail, based on the graded approach described in Chapter 1, to permit facility engineering, procurement, operations, and maintenance personnel: (1) to identify all safety design and configuration commitments that must be met, and (2) to identify the consequent changes that must be made if an altered safety commitment is contemplated.

Example page from a PSAR showing the kinds of engineered safety features (ESFs) typically presented.

4.3 Engineered Safety Features (ESF)

The accident analysis (Chapter 11) is the basis for identifying safety-related systems and administrative controls necessary to operate the GIF safely. Identifying the engineered safety features (ESFs) for the GIF is not straight forward. This is because most definitions/regulations in Division 1300 of DOE Order 5430.1A aim at facilities that process radioactive materials; the GIF merely uses solid, sealed radioactive sources for providing high-energy gamma photons.[3] As noted in chapter 6, none of the 20 special facilities under Division 1300 of the Order apply to the GIF, and only the general nuclear facility criteria are applicable. Because the GIF has a Category 3 hazard classification, it has no credible accident sequences that adversely affect the public, environment, or onsite personnel. Applying these conditions to the order's strict definitions of ESF, safety class items, and safety classes is ambiguous. Therefore, the single term "Safety Class Item" is used in the PSAR to identify any safety-related feature that satisfies the definition of an ESF. The three levels of safety classes are not distinguished or used in this PSAR.

4.3.1 ESF Identification

ESFs are defined in DOE Order 6430.1A as: "Systems or design characteristics that are provided to prevent or mitigate the potential consequences of postulated design basis accidents. An engineered safety feature system is a safety class system." The order defines safety class items as : Systems, components, and structures, including portions of process systems whose failure could adversely affect the environment or the safety and health of the public. Specifically, safety class items are those systems, components, and structures with the following characteristics:

1. Those whose failure would produce exposure consequences that would exceed the guidelines in Section 1300.4, *Guidance on Limiting Exposure of the Public*, at the site boundary or nearest point of public access.
2. Those required to maintain operating parameters within the safety limits specified in the OSRs during normal operations and anticipated operational occurrences.
3. Those required for nuclear criticality safety.
4. Those required to monitor the release of radioactive materials to the environment during and after a DBA.
5. Those required to achieve and maintain the facility in a safe shutdown condition.
6. Those that control the safety class items described above."

Characteristics 1,3, and 4 have no applicability to the GIF because the facility has a Category 3 hazard classification, with no fissile material. Characteristics 2, 5, and 6 are the most applicable. Based on the above definitions and the accident analysis in Chapter 11, the following five GIF systems are determined to be ESFs and safety class items.

Engineered Safety Feature	Primary Safety Function
1. Source cladding	Containment of radioactive material
2. Water pool	Radiation shielding
3. Irradiation cell shield	Radiation shielding
4. Door/elevator power switch	Access control
5. Radiation monitoring system	Detection of radiation conditions

Although other systems/subsystems help an operator perform tasks, these four systems alone will prevent and mitigate the consequences of all postulated DBAs to a low overall risk. As already noted, strict adherence to the administrative controls, as stipulated in the basis of TSAs in Chapter 16, is assumed in making this determination. Other systems may provide backup functions which parallel the safety functions inherent in the ESFs.

4-5

Figure 2.11. Example Page from a PSAR Showing Engineered Safety Features Information. *This example illustrates the typical kinds of ESF information required for describing the facility and its operations.*

2.10 HAZARD ANALYSIS AND CLASSIFICATION OF THE FACILITY

2.10.1 Objectives

Describing the information necessary to meet all objectives within the prescribed scope of the hazard analysis provides a basis for performing the accident analysis.

The writer's objective for this SAR topic is to identify and clarify the following:

1. The inventory envelope of hazardous materials, by type and amount, expected to be encountered in facility operations;
2. The energy sources and release mechanisms necessary to perform a facility hazards assessment; and
3. The results of bounding analyses for each type of hazard presented.

2.10.2 Scope

Based on the hazard assessment, the hazard level classification of the facility will be specified in accordance with the classification scheme presented in DOE-STD-1027-92 and paragraph 8.c of DOE Order 5480.23.

2.10.3 Hazard Level Classification of Facility

Specify the hazard level classification per DOE-STD-1027-92 and paragraph 8.c of DOE 5480.23.

DOE Order 5480.23 provides criteria for classifying the hazards of DOE nuclear facilities and operations. The hazard classification scheme is based on the potential consequences of an unmitigated release of the entire hazardous material inventory as follows:

- Category 1—potential for significant offsite consequences.
- Category 2—potential for significant onsite consequences.
- Category 3—potential for only significant localized consequences.

Additional hazardous facility screening guidance is provided in DOE-STD-1027-92 to ensure a consistent hazard classification among DOE facilities and operations.

Hazard Category 1

Hazard Category 1 includes:

- Facilities with Class A reactors (steady-state power level greater than 20 megawatts), and
- Facilities designated by the DOE Program Secretarial Officer (PSO) based on the need for offsite emergency planning.

Hazard Category 2

Hazard Category 2 includes:

- Facilities with the potential for nuclear criticality events, and
- Facilities with hazardous material and energy quantities sufficient enough to require onsite emergency planning.

This category typically includes nuclear fuel cycle facilities, Class B reactors, and nuclear material processing facilities.

NOTE: Table A.1 of DOE-STD-1027-92 provides the radionuclide quantity and activity values that define the threshold quantities for a Category 2 facility.

Hazard Category 3

Hazard Category 3 includes facilities such as laboratories and low-level waste facilities. Unmitigated releases of hazardous materials from a Category 3 facility would not require initiation of either onsite or offsite emergency activities.

NOTE: Table A.1 of DOE-STD-1027-92 provides the radionuclide quantity and activity values that define the threshold quantities for a Category 3 facility.

Collocated (Segmented) DOE Operations.

An issue that is relevant to both the graded approach and the facility hazard classification is the concept of a "facility" with respect to *collocated* DOE operations.

Defining a large DOE facility in terms of well-differentiated and independent operations may hold advantages. However, "segmentation" of collocated facilities is allowable only when the accidents associated with a defined segment DO NOT interact with the hazardous situations in any other collocated segment.

Further, a specific operation or activity (segment) may be excluded from the scope of a SAR only if the two following criteria are met:

- Mechanisms for hazardous events within the subject segment originate entirely within the segment, and
- None of the events within the segment provides input for any hazard mechanisms addressed in the safety analysis.

Consequently, where applicable, a SAR must address common mode failure mechanisms and coordination of safety requirements among collocated operations.

On the following page, Figure 2.12 shows an example presentation for a SAR. This example illustrates (in abbreviated format) the kinds of information that should be included.

2.11 RADIOACTIVE AND HAZARDOUS MATERIAL WASTE MANAGEMENT

2.11.1 Objectives

The writer's main objective for this SAR topic is to provide essential information DOE needs to evaluate the safety analysis relating to all radioactive and hazardous material wastes at the facility.

2.11.2 Scope

The scope of information to be presented in the SAR covers the following:

The scope of this topic encompasses six main categories of information.

- Estimates of quantities and forms of radioactive and hazardous material wastes;
- Equipment, provisions, and plans for managing radioactive and hazardous material wastes;
- Waste management processes;
- Waste sources and characteristics;
- Waste treatment systems; and

Example from a SAR showing the categories of information appropriate for a hazard analysis.

5.0 HAZARD ANALYSIS AND CLASSIFICATION OF THE FACILITY

5.1 Hazard Classification Methodology

5.1.1 Regulatory Guidance

In accordance with DOE 5480.23[1], the hazard classification for nuclear facilities must be based on the inventory of materials, the material form, and the potential energy sources involved in postulated bounding accident scenarios. Guidance in application of these criteria is provided in DOE-STD-10272. . .

5.2 Definition of Facility and Major Operations

The proposed GIF facility will house three large, dry irradiation cells. The cobalt-60 sources to be used in the cell will be stored in a 5.5-meter-deep aqueous pool below. The sources may be raised into the cell by means of elevator, accessing the cells from the pool below. Up to 0.5 megacurie of cobalt-60 may be raised into each cell at one time. . . .

5.3 Hazard Identification, Characterization, and Screening

The GIF facility will house large gamma ray sources for dry irradiation of test items and for wet irradiation of items within the storage pool. The primary hazards are large quantities of cobalt-60 and cesium-137. These are sealed sources. Although the source term is large, the form, usage, and storage conditions for these materials are such that the facility presents a low hazard. . . .

5.4 Worst Case Release Fractions and Source Terms

The radioactivity contained within the GIF could pose a serious hazard to workers in the immediate vicinity in the unlikely event that all administrative controls and engineered safeguards were to fail.
.....

5.5 Worst-Case Consequence Analysis

For the reasons summarized above, potential is negligible for the source terms within the GIF to impact workers outside the facility or the public. The worst-case consequence would involve worker injury or fatality within the facility as a result of failure of the multiple levels of preventive, detection, and mitigation features. . . .

5.6 Facility Hazard Classification

Based on the lack of energy sources to disperse the radioactive inventory, the GIF has been determined to be a Category 3 nonreactor nuclear facility. This classification has been submitted to DOE/KAO and approved as witnessed by the SSD form in Attachment 5-1. . . .

5-4

Figure 2.12. Example Showing the Kind of Information Typically Presented in a SAR Hazard Analysis. *The data must support the hazard analysis of the facility as it is classified based on DOE 5480.23 and DOE-STD-1027-92.*

- Special waste minimization programs.

On the following page, Figure 2.13 shows an example of a page from a SAR discussing this topic.

2.11.3 Specifically Required Information

The writer must provide estimates of the quantities and forms of radioactive wastes generated as part of the mission of each DOE nuclear facility.

Also to be addressed is the installed equipment, provisions, and plans for managing these wastes. Preparers and writers of SARs must provide enough detail to support accident analysis needs. This includes enough detail to allow DOE to determine whether or not adequate protection is being afforded the public, workers, and environment through compliance with the requirements of DOE Order 5820.2A, *Radioactive Waste Management.*

Along with the above information, the writer should present the information identified below.

2.11.3.1 Waste Management Process

The writer should present data on:

- Overall philosophy, objectives, and general process for handling the different forms of radwaste (or mixed waste), and
- Administrative and operational controls important to the effective management of the different waste forms.

2.11.3.2 Waste Sources and Characteristics

The writer should also focus on:

- How and where the waste is generated;
- How the waste enters the appropriate waste handling or treatment systems;
- Waste source quantities;

Example page from a SAR showing the kinds of information appropriate for this topic.

7. RADIOACTIVE AND HAZARDOUS MATERIAL WASTE MANAGEMENT

7.1 OBJECTIVE

This chapter contains descriptions of those systems and associated equipment installed in the Annular Core Research Reactor facility that control the radioactive waste that might be generated during reactor operations. Core fission products and coolant activation products are the primary radioactive materials that could be present in the primary coolant. Fuel particles might also be present in the coolant.

The water treatment system cleanup loop removes any radioactive materials present in the coolant. The cavity purge system is the principal gaseous waste system, since it controls air flow through the experiment spaces, where it is expected that radioactive gaseous wastes most likely would be generated. Argon gas in the experiment cavity could become activated, and if an experiment containment ruptured, radioactive gaseous effluents such as fission products would likely be released into the purge air stream.

The level of activity associated with these wastes is monitored by installed radiation monitoring systems and by Radiation Protection Operations personnel. The purpose of monitoring is to ensure that the activity levels measured for the various effluent streams do not exceed the allowable limits prescribed in DOE Order 5400.5.

The systems described herein are not required for safe operation of the facility, because of the low fission product inventory of the reactor core, the minimal requirements of water or other liquids in support of operational activities, and the small amounts of radioactive materials generated within the facility (exclusive of the core) during these activities. Normal ACRR operating practices and procedures, however, do require the use of some of these systems during operation of the reactor.

7.2 ARGON-41 PRODUCTION

Argon-41 activity can result from irradiation of air dissolved in the coolant and irradiation of air in the experiment cavity. Argon in the pool water is generated according to the reaction:
$^{40}Ar\ (n,y)\ ^{41}Ar$

Assuming a saturation concentration of argon in water, . . . etc.

7.3 REACTOR COOLANT CLEANUP LOOP

A skimmer extracts a small amount of water from the top of the reactor pool for processing through the cleanup loop. This water is pumped through a system containing two filters, a demineralizer, a turbine flowmeter, two resistivity cells, a ph meter, and . . . .

7-3

Figure 2.13. Example Page from a SAR Showing Typical Radioactive and Hazardous Material Waste Management Information. *The text should include illustrations of all essential processes and equipment to help the DOE reader evaluate the information.*

- Chemical forms and characteristics of the wastes;
- Physical characteristics of the wastes; and
- Radiological and toxic/radiological compositions.

2.11.3.3 Waste Treatment Systems

Another category of information the writer should cover involves waste treatment systems. This subject includes:

- Methods used to control or mitigate potential impacts of different waste forms, and
- Operating principles, functions, and performance objectives of waste handling equipment and systems.

2.11.3.4 Waste Minimization Programs

If appropriate, this topic discussion should also include essential information on any waste minimization programs under way at the facility.

NOTE: Engineering drawings of facilities, systems, components, processes waste sources, etc. should be provided to illustrate process flow paths as well as system equipment instrumentation.

2.12 INADVERTENT CRITICALITY PROTECTION

2.12.1 Objectives

Provide sufficient information to show compliance with applicable requirements of DOE 5480.24.

The writer's objective for this topic is to provide sufficient SAR information to prove nuclear facility compliance with applicable requirements for preventing inadvertent nuclear criticality in accordance with DOE Order 5480.24, *Nuclear Criticality Safety*.

NOTE: Hazard Category 3 facilities, by definition, do not contain enough fissile material to present a criticality hazard. Thus, this topic is not

applicable to SNL Hazard Category 3 facilities (Ref. DOE-STD-3009-93 [Draft]).

More information on applicable requirements is contained in Chapters 7 and 8 of the Sandia National Laboratories ES&H manual.

2.12.2 Scope

The scope of this style guide section covers the following:

- Applicable requirements;
- Criticality Safety Analysis (CSA); and
- Essential elements of the nuclear criticality safety program.

On the following page, Figure 2.14 shows an example of a page from a SAR that presents typical information for this Inadvertent Criticality Protection topic.

2.12.3 Applicable Requirements

Two closely related requirements apply to this topic.

Two closely related requirements that invoke several industry standards are applicable to this topic:

1. Fissile materials must be produced, processed, stored, transferred, and disposed of or handled so that the probability of a criticality incident occurring is acceptably low. Also, to the extent practical, government and private personnel and public and private property are to be protected from damaging effects and undue hazards that may arise from a criticality incident.

This example page shows only a sample of the kinds of information typical for this DOE-required SAR topic.

8. INADVERTENT CRITICALITY PROTECTION

8.1 Objective and Scope

The objective of this chapter is to describe administrative and operational controls that assure a nuclear criticality will not occur at the GIF. Fissile materials are not used or stored at the GIF, but some experiments may contain fissile materials. Therefore, the scope of this chapter focuses mainly on the administrative aspects of the present Nuclear Criticality Safety Program, which is part of the overall ES&H program for the laboratory.[1]

Because this document is a PSAR, the descriptions, discussions, and commitments made in this chapter are preliminary. An updated, detailed account of the Nuclear Criticality Safety Program and its implementation at the GIF will be given in the FSAR.

8.2 Criticality Concerns

Fissile materials are not used or stored at the GIF. Their presence will be limited to select test units brought into the GIF on a case-by-case basis. Those tests involving considerable amounts of fissile materials will be reviewed by the TA-V Radiological and Criticality Safety Committee (RCSC).[2] Assurances must be provided that the proposed test will not introduce criticality safety issues into the facility. In most cases, criticality safety will be part of the engineering design of the unit itself. Additional controls will be implemented as the RCSC deems necessary.

The type, quantity, and form of fissionable material will vary depending on the test unit. No inventory of fissionable material will be maintained at the GIF because no storage is permitted. Fissile materials at SNL usually are uranium enriched with U^{235} and plutonium enriched with Pu^{239}.

Test units will be brought into the GIF and will usually be loaded into a dry cell for irradiation. Most experiments using fissile material would require dry rather than wet irradiation cells. Long-term storage of a unit, if necessary, would be at one of the approved SNM vaults located at TA-V.

8.3 Criticality Safety Requirements

The safety of all fissile material brought into the GIF will be established according to existing SNL standards and verified by RCSC review. The SNL's *ES&H Manual* provides guidance on criticality at SNL. The Nuclear Criticality Safety Program, described in the *ES&H Manual,* meets the requirements of DOE Orders 5480.5, 5480.6, 5480.21, and 5480.23.[3,4,5,6] This program also uses as a basis the following standards: ANSI/ANS 8.1, 8.3. 8.5, 8.7, 8.10, 8.12, 8.15, and 8.19.[7]

8.4 Nuclear Criticality Safety Program

SNL currently has a Nuclear Criticality Safety Program to support fissile experiments performed at the laboratories and specifically to support the nuclear facilities (including four reactors) in TA-V. This program has serviced a wide variety of experiments, critical experiments, and reactor. . . .

8-1

Figure 2.14. Example Page from a PSAR Showing Typical Inadvertent Criticality Protection Information. *Information presented in the SAR should also include all references governing the Nuclear Criticality Safety Program along with the specific activities designed to prevent inadvertent nuclear criticality accidents.*

2. The basic elements and control parameters of nuclear criticality safety programs must also satisfy the requirements of:

   - ANS-8.1
   - ANS-8.3
   - ANS-8.5
   - ANS-8.7
   - ANS-8.15
   - ANS-8.19

   DOE Order 5480.24 specifically references these standards.

Additional information on applicable requirements can be found in Chapters 12 and 19 of the SNL ES&H manual.

2.12.4 Criticality Safety Analysis

The SAR preparer must identify the types of fissile materials present in the facility, the form(s) of the materials (e.g., solid, aqueous, powder), isotopic compositions, locations, and maximum anticipated inventories of these materials.

Based on this information, the SAR should contain four specific types of information:

The SAR must contain four specific types of data based on comprehensive analyses of operations involving fissile materials.

1. Results of a criticality safety analysis of each operation involving significant quantities of fissile material;

2. Description of the criticality accident alarms established on the basis of these analyses, if criticality accidents are determined to be credible;

3. Descriptions of the locations of these alarms, if criticality accidents are determined to be credible; and

4. Identification of all criticality safety limits.

Additional information on applicable requirements can be found in Chapters 4 and 6 of the SNL ES&H manual.

2.12.5 Essential Elements of the Nuclear Criticality Safety Program

Base the description of the nuclear criticality safety program on planning activities and conduct of facility operations.

The SAR writer should describe two especially important elements of the facility nuclear criticality safety program that ensure nuclear criticality safety: the planning activities, and the conduct of facility operations.

Include the following in describing the two elements:

- Criteria used to ensure **subcritical** situations during operations and storage under the worst credible conditions (including geometry controls and administrative controls on material mass, material density, neutron absorption, and neutron moderation);
- Parameters used in prevention and control of criticality events during activities involving fissile materials;
- Application of the *Double Contingency Principle* for criticality safety;
- Criticality safety design limits, their bases, and any design criteria that ensure criticality safety limits are not exceeded;
- Error contingency criteria selected for the facility;
- Criteria for establishing criticality protection verification; and
- Applicable plans and procedures for the handling of fissile materials, including:
  - Material receipt and inspection;
  - Onsite loading, unloading, and transportation;
  - Onsite storage; and
  - Materials disposal.

Additional information on applicable requirements can be found in Chapter 15 of the SNL ES&H manual.

2.13 RADIATION PROTECTION

This topic applies whenever a radiological hazard exists in a facility or operation.

2.13.1 Objective

Provide sufficient information to show compliance with: DOE 5480.11; ALARA; all radiation protection criteria involving dosimetry, instrumentation, and calibration; and radiological protection programs for the facility.

The SAR writer's objective for this topic is to present sufficient information to show compliance with the radiation protection requirements of DOE 5480.11, *Radiation Protection for Occupational Workers*.

2.13.2 Scope

The scope of information presented for this SAR topic must include discussions of the following subjects:

- As-Low-As-Reasonably-Achievable (ALARA) policy/ program;
- Dosimetry and radiation exposure control;
- Radiological protection instrumentation calibration/use;
- Respiratory protection;
- Radiological monitoring and contamination control;
- Radiological area posting and access control;
- Radiological protection training; and
- Radiological protection record keeping.

The SAR writer must ensure that descriptions of applicable engineered controls (e.g., for confinement, ventilation, remote handling, equipment layout, and shielding) and administrative controls have sufficient detail to support these discussions.

On the following page, Figure 2.15 shows an example of a page from a SAR typical for this topic.

2.14 HAZARDOUS MATERIAL PROTECTION

2.14.1 Objectives

Provide details sufficient to show compliance with applicable requirements including 29 CFR 1910.119, for controlling personnel exposure to hazardous materials.

The SAR writer's objective for this topic is to present sufficient information to prove compliance with applicable requirements for control of personnel exposures to hazardous materials. These requirements are those found in 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals.*

NOTE: Hazardous material containing radioactive elements is subject to both radioactive and hazardous material controls. The purpose is to ensure adequate protection of facility workers and the general public. The SAR preparer must therefore address applicable controls in both the radiation protection and hazardous material protection program topics for such material.

2.14.2 Scope

The scope of the subject matter that should be addressed in the SAR include:

The scope should include these seven subjects.

1. As-Low-As-Reasonably-Achievable (ALARA) policy/program;
2. Bioassay or medical monitoring activities;
3. Air and workplace monitoring;
4. Maintenance and calibration of monitoring instrumentation;
5. Hazardous material exposure record keeping;

9.0 RADIATION PROTECTION

9.1 Objectives

The objective of this chapter is to describe the general radiation protection program as established for the routine operation of the Annular Core Research Reactor (ACRR) facility.

9.2 Scope

Information is included on the facility features which impact radiation protection and the equipment routinely available for monitoring radiation. Responsibilities of the operations group and the onsite health physics staff are described.

9.3 Radiation Concerns and Sources

The primary source of radiation in the ACRR facility is the reactor core. The core contains fuel elements, six fuel-followed control rods, and two fuel-followed safety rods for a total core inventory of about 24 kg of U^{235}. Fission products resulting from steady-state and pulse operations produce high levels of radiation; however, the water in the reactor tank attenuates the radiation levels at the core position.

Preparers and writers of SARs must ensure that radiation protection data address DOE Order 5480.11 requirements.

Secondary sources of radiation are the experiments that may be irradiated in the experiment cavity. Experiment contents may consist of small quantities of fissile material or other materials that become radioactive when exposed to the flux in the cavity. The amounts of material allowed in the reactor experimental facilities are limited to small quantities, and the experiments are reviewed by the reactor safety committees.

Materials in experiments may be in any physical or chemical form. These materials are contained in leak-tested containments to ensure that significant leakage into the reactor tank or the dry experiment cavities does not occur.

Airborne radioactive sources are typically materials used in experiments that may exhaust into the high bay environment, either as a result of required or unintentional venting of the experiment container. Other airborne sources of radioactivity may consist of small amounts of Ar^{41} (from central cavity and FREC cavities) and N^{16} (from the reactor tank).

9.4 Engineered Radiation Protection Controls

Biological shielding is provided by inherent ACRR design features. The water in the reactor tank is the most important shielding feature. The approximately 6 meters of water above the core reduces radiation to acceptably low levels for both steady-state and pulse operations. The reactor tank is embedded in a concrete shell. This shell in turn is buried in compacted earth fill up to about 1.2 meters from the top of the tank. A large block of high-density concrete. . . .

9-1

Figure 2.15. Example Page from a SAR Showing Typical Radiation Protection Information. *The discussion should include all information necessary to prove to decision makers that the facility meets all radiation protection guidelines required by DOE.*

6. Hazard evaluation and elimination activities; and

7. Hazard communication.

2.14.3 Depth of SAR Presentation

The writer must be certain to address these subjects comprehensively in the SAR to furnish all the information needed by decision makers. Preparers and writers of SARs must therefore also describe the applicable **administrative controls** and the **engineered controls** (e.g., confinement, ventilation, remote handling, equipment layout, etc.) to support these subjects.

2.15 ANALYSIS OF NORMAL, ABNORMAL, AND ACCIDENT CONDITIONS

2.15.1 Objectives

SAR preparers and writers should consult DOE 5480.23 to ensure information presented for this SAR topic meets all requirements.

The SAR writer's objective is to furnish details of the facility safety analysis in accordance with the requirements of DOE 5480.23, *Nuclear Safety Analysis Reports*.

2.15.2 Scope

The scope of subject matter that must be covered in the SAR for this accident analysis topic includes the following:

Nine major subjects should be covered in this SAR topic.

1. Methods for identifying, investigating, and controlling facility vulnerability to accidental radiological exposures and releases of hazardous materials ;

2. Spectrum of analyzed accident sequences or release scenarios;

3. Design basis accidents (DBAs);

4. Beyond design basis accidents (BDBAs) for the facility;

5. Compliance with applicable health and safety criteria;

6. Derivation of importance-to-risk and importance-to-safety measures to demonstrate defense-in-depth;

7. Derivation of environmental qualification requirements for safety-related equipment;

8. Safety-Class Barriers; and

9. Summary of accident analysis results.

In documenting the accident analysis in the SAR, include all assumptions and boundary conditions used in the analysis, all bases for the application of specific analytical models and logic processes, and all summary conclusions drawn from the analysis.

Detailed calculations and other information pertinent to the analysis may be presented in separate referenced documents subject to appropriate configuration management controls.

Use the "graded approach" to address accident analyses.

On the following page, Figure 2.16 shows an example page from a SAR that uses the graded approach to address the accident analysis performed for a Hazard Category 3 facility. Since the potential accident consequences for such a facility are, by definition, well below offsite evaluation guidelines, providing only a summary of the maximum consequences expected from facility operations is appropriate. Also, state that detailed accident quantification is not required.

2.15.3 Methods for Identifying, Investigating, and Controlling Facility Vulnerability to Hazardous Materials Release Accidents

The methods used in accident analyses include, but are not limited to, the following:

- Deterministic safety analysis;
- Probability risk assessment;
- Reliability engineering;
- Failure modes and effects analysis;
- Common-cause failure analysis;
- Event-tree analysis;
- Fault-tree analysis; and/or
- Human reliability analysis.

Five tasks are involved in accident analyses:

Five key tasks are involved in performing the accident analysis. These tasks govern which methods are to be used in the analysis. The five tasks are described below.

11.4 ANALYSIS METHODOLOGY FOR ABNORMAL AND ACCIDENT CONDITIONS

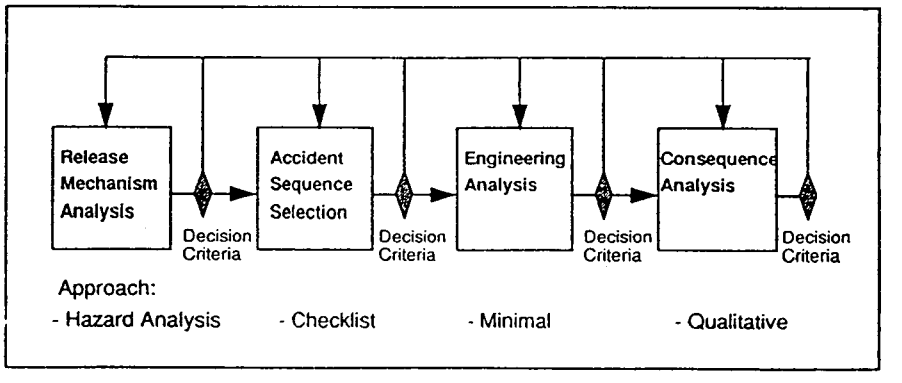
DOE Order 5480.23, and accompanying guidance DOE-STD-1027, classify nuclear facilities and activities into three hazard categories based on the consequences for an unmitigated release of the radioactive/hazardous material. The safety documentation requirements are graded depending on the category of a nuclear facility. Category 3 is the least hazardous with the potential only for significant localized consequences and no potential for significant on-site or off-site consequences. Safety Analysis Reports are required for all categories of nuclear facilities. For Category 3 facilities, the SAR accident analysis is only required to be a qualitative assessment instead of quantitative as required for the other categories. Without numerical evaluation, there are no criteria for determining if safety-related features are adequate for a given hazard. Therefore, a methodology has been developed for evaluating safety-related features of a Category 3 non-reactor nuclear facility in the absence of a quantitative analysis. This methodology has been applied to the safety analysis of the GIF.

According to STD-1027 guidance on the application of the graded approach, the four elements of a Category 3 safety analysis were addressed as follows (also shown in Figure 11-5):

- The release mechanisms are only focused on unique scenarios which could adversely effect the health and safety of workers in the facility.
- The accident sequence selection was completed by a checklist to ensure a comprehensive list of potential accident conditions are qualitatively considered.
- Only a limited engineering analysis was performed to determine the effectiveness of preventative and mitigate features.
- A qualitative consequence analysis for each identified accident sequence determined the overall risk level (consequence and probability) for that accident.

After each step in the technique, a decision to proceed with the analysis or to change the design was made based on the criteria that the overall risk of the accident could be limited to a low level.

Figure 11-5 Application of the Graded Approach Technique to the GIF Accident Analysis



11-3

Example from a SAR that applies the "graded approach" rather than a full-blown presentation of an accident analysis for a Hazard Category 3 facility.

Figure 2.16. Example Page from a SAR Showing Application of the Graded Approach. *Since the potential accident consequences for a Hazard Category 3 facility are, by definition, well below offsite evaluation guidelines, only a summary of the maximum expected consequences from facility operations is needed along with a statement that detailed accident quantification is not required.*

Task 1

Task 1 requires each hazardous chemical and radiological material present or permitted in a facility to be identified and characterized in terms of its:

- Physical state (solid, liquid, powder, etc.);
- Location; and
- Maximum quantity.

Task 2

Task 2 requires identification of the energy sources and events that could impact the material and potentially lead to a release, including:

- Operational events such as spills, fires, explosions, and nuclear criticality;
- Natural phenomena such as earthquakes, tornadoes, and floods; and
- Man-made external events such as transportation accidents and accidents at nearby facilities.

Task 3

Task 3 requires identification of those features (barriers) that protect the hazardous material from the effects of energy sources, thereby preventing release of the material into the facility atmosphere.

Barriers may take the form of engineered safety features or administrative controls. In the analysis of accidents, engineered barriers generally:

- Eliminate or isolate a hazard from the scene in which it exists as a hazard;
- Terminate a potentially hazardous event sequence; and/or
- Re-direct a hazardous sequence to an acceptable consequence.

Administrative controls can either remove hazardous materials from the range of potential energy sources or reduce the likelihood of an initiating event caused by human performance error or equipment failure.

Task 4

Task 4 requires identification of those features that mitigate the release of material to the environment.

Challenges to hazardous material barriers are identified by the physical conditions defined in the accident scenario. If the accident

challenges barriers at the levels of their design limits, or if some known likelihood exists of barrier failure, then an assumption must be made about the degree of failure between total failure and partially degraded function.

Task 5

Task 5 requires specification of the assumptions upon which the results of the analysis depend, and the bases thereof.

Analyses to determine the likelihood of hazardous material barrier failures should include the effects of aging, erosion, corrosion, and other similarly degrading forces on the ability of barriers to function as designed. The degree of conservativeness incorporated in assumptions about the extent of barrier failure will depend on the amount of information available to the analyst. If total failure is not assumed, the SAR must address the analysis that provides the basis for the assumed degree of failure.

2.15.4 Spectrum of Analyzed Accident Sequences or Release Scenarios

The accident analysis must identify the **spectrum** of accident sequences or release scenarios. The scenarios may range from high likelihood-low consequence events to low likelihood-high consequence events. The accident analysis must also identify the **specific** accident scenarios considered.

Based on the accident analysis results, accident scenarios should fall into three groups:

Accident scenarios fall into three groups.

1. Those that require no further attention;

2. Those that can be mitigated or eliminated via changes in design parameters and/or operational procedures; and

3. Those that require further quantification based on a need for better understanding of the event (e.g., motivated by severe consequences, high likelihood of occurrence, or large uncertainties in the scenario due to the complexity of processes, components, and structures involved in the accident evolution).

   NOTE: If a "qualitative" analysis indicates that a potential accident results in only negligible offsite consequences, then a rigorous, "quantitative" analysis is not required.

A quantitative analysis is called for ONLY when the results of a qualitative analysis approach accident evaluation guidelines.

On the following page, Figure 2.17 shows, in truncated format, an example page from a SAR that illustrates the spectrum of accident sequences analyzed for a Hazard Category 3 facility.

2.15.5 Design Basis Accidents (DBAs)

DBAs

Design Basis Accidents are selected from the group of operational, natural phenomena, and external event sequences that are analyzed in the accident analysis. The results of health effects calculations for these event sequences are compared with established acceptance criteria to identify those events which may exceed the criteria. Such events become DBAs for the facility/operation. The accident analysis should describe **why** specific DBAs have been selected to provide the design parameters for release barriers and mitigating systems.

2.15.6 Beyond the Design Basis Accidents (BDBAs)

BDBAs

The accident analysis should present data on the likelihood of occurrence and the consequences resulting from accidents beyond the design basis accidents (BDBAs).

BDBAs are extremely low-probability accident scenarios which will result in potentially greater consequences than DBAs. Such accidents could result from failure of previously-assumed-functional safety-class structures, systems, and components. This information is often necessary to provide a rationale for acceptance or rejection of facility operation and to estimate the residual risk associated with facility accidents.

Specifically, BDBAs must be examined and be made part of the safety analysis to:

- Identify the most likely severe accident sequence to which a nuclear facility or operation may be subjected;
- Provide an understanding of the likely facility behavior under severe accident conditions as well as the magnitude of the potential consequences; and

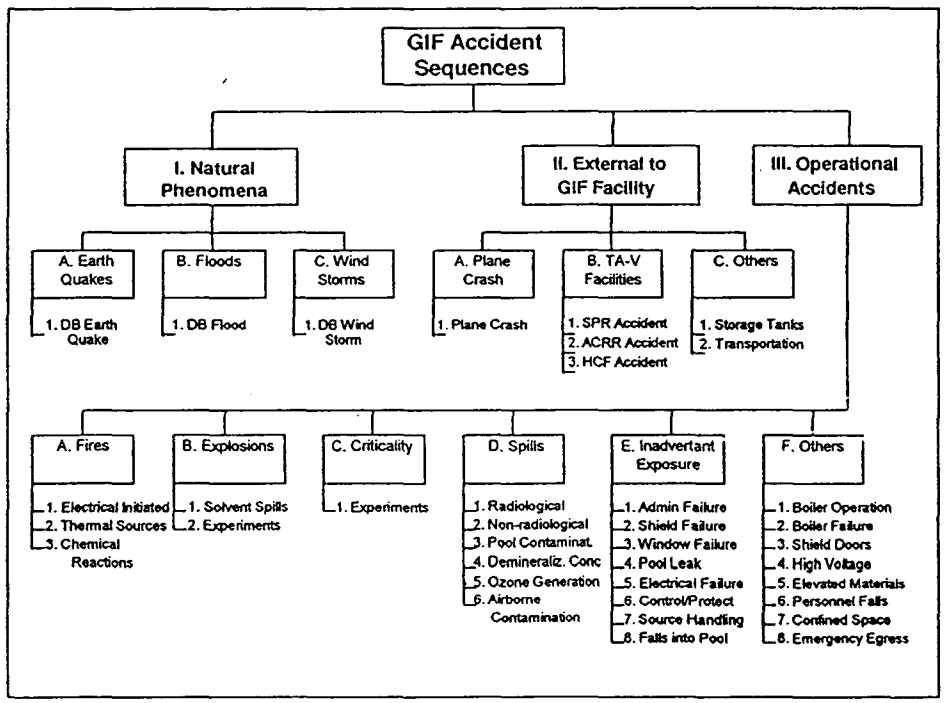
This example uses an abbreviated format to show how to present accident sequences analyzed for a SAR.

11.4.3 Accident Sequence Analysis

The accidents analyzed for the GIF are shown in Figure 11-6. The accidents are divided into three categories: 1) natural phenomena events, 2) accidents originating external to the GIF, and 3) operational accidents at the GIF. For some accidents, dissimilar initiators of different probabilities can lead to the same sequence and similar consequence. These are treated as separate accidents in the analysis. .....

The GIF accident analysis is summarized in Table 11.5 For each accident, a qualitative assessment of the overall risk is determined with consideration for the cause, preventive features, detection methods, mitigative features, and consequences. .....

Figure 11-6. Accident Sequences Analyzed for the GIF



11-5

Figure 2.17. Example Page from a SAR Illustrating the Spectrum of Accident Sequences Analyzed. *This figure shows, in truncated format, how a SAR can illustrate the spectrum of accident sequences analyzed for a Hazard Category 3 facility.*

- Identify specific facility vulnerabilities that can be fixed by means of low-cost modifications.

NOTE: Beyond design basis accident evaluation is not required for Hazard Category 3 facilities nor for Hazard 2 Category facilities that do not exceed offsite evaluation guidelines from unmitigated releases (Ref. DOE-STD-3009-93 [Draft]).

2.15.7 Compliance with Applicable Health and Safety Criteria

Provide data as required by DOE 5400.5 and 5480.11 that show facility programs ensure adequate health and safety protection for onsite personnel and offsite communities.

The accident analysis must show health and safety compliance with:

- DOE Order 5400.5, "Radiation Protection of the Public and the Environment," and
- DOE Order 5480.11, "Radiation Protection for Occupational Workers."

The accident analysis must also show adequate protection for the:

- Health and safety of members of the general public, both on and off the DOE site at which the facility is located;
- Health and safety of workers on the site not involved in or responsible for the facility or its safety;
- Health and safety of facility workers; and
- Environment from accidental contamination by the facility.

Other health and safety data are also needed.

The accident analysis should also provide the basis for evaluating incentives and priorities for alternatives that might reduce facility risks. This information should include the bases for prioritizing upgrades and cost/benefit evaluations of tradeoffs between alternatives in design, operation, and maintenance. The analysis also should consider the differences in the effectiveness and the attendant risks of alternative safety provisions.

2.15.8 Application of Safety Importance Measures to Demonstrate Defense-in-Depth

The purpose of this section is to demonstrate the defense-in-depth nature of facility safety.

In this section, the SAR preparer/writer should describe the basis for measures of safety importance and how they are applied to a hierarchy of safety provisions. The discussion should also define the set of requirements that will ensure the availability of structures, systems, and components (SSCs) that provide necessary safety functions.

The hierarchy of safety provisions discussion should identify the particular SSCs that constitute various levels of the defense-in-depth approach to ensuring overall facility safety. SSCs that have been explicitly or implicitly relied upon during the accident analysis to prevent or mitigate potential accident consequences will include:

- Safety-class SSCs;
- Safety-significant SSCs; and
- Other SSCs that may be considered important-to-safety from the perspective of accident prevention or mitigation.

The hierarchy of safety provisions is analogous to safety classification schemes. That is, safety classifications provide an indication of the importance-to-safety of various functions provided by facility SSCs. The hierarchy should identify, as a minimum, safety-class SSCs, safety-significant SSCs, and any other equipment that provides protection, either directly or indirectly, for facility workers.

2.15.9 Derivation of Environmental Qualification Requirements for Safety-Related Equipment

Evaluate how equipment and the facility could be affected by accident conditions.

An accident analysis must address the derivation of equipment operating environment parameters for safety-related equipment. The information presented must establish the environmental conditions (e.g., the radiation levels, humidity, pressure, temperature) that could be created in areas containing safety-related equipment by credible accidents (likelihood of occurrence greater than 1×10^{-6} per year), during which the equipment would be called upon to function.

An accident analysis should present information that validates the capability of this equipment to withstand the conditions and to accomplish the intended safety-related function.

2.15.10 Safety-Class Barriers

Barriers designed to prevent acceptance criteria in any mode of operation from being exceeded are designated as "safety-class."

Barriers are hazard control measures. Barriers that must function so that offsite health effects acceptance criteria are not exceeded in any mode of operation are designated as "safety-class."

An important concept in determining safety-class systems is the **primary success path**. This path is the sequence of events that leads to a transient or accident conclusion having acceptable consequences.

Hardware providing a necessary prevention and/or mitigation function in a primary success path is designated as "safety-class".

Support and actuation systems also are safety-class if they are needed to assure performance of the safety function.

The primary success path identifies the limiting conditions for operation.

Accident analysis results establish the adequacy of hazard control measures (barriers). The analysis identifies the primary success path and the minimum control measure performance requirements under the expected conditions of the accidents analyzed. Primary success paths are thus used to identify the *limiting conditions for operation.*

> **NOTE: Limiting conditions for operation should be included in the Technical Safety Requirements document.**

The accident analysis should lead to specific results.

Results of the accident analysis should provide the basis to clearly establish the following:

- Operating limits, limiting control settings, safety limits, and limiting conditions for operation (see Figure 2.18);
- Safety-class hardware;
- Special administrative controls/actions required for operational safety;
- Safety significance of each safety-class barrier;
- Accident sequences that are the dominant contributors to risk;
- Environmental conditions within which safety-class hardware must remain functional;
- Critical human performance failures and the controls required for prevention or mitigation;

SAR preparers must take into account various governing limits in presenting accident analyses.

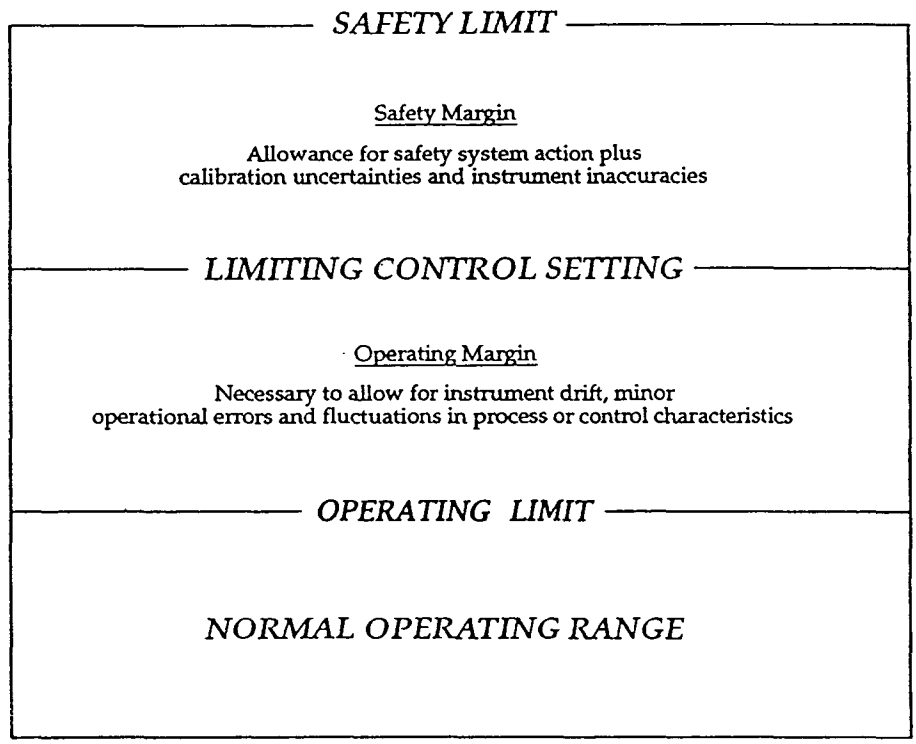


Figure 2.18. Illustration of the Relationship Among Operating Limit, Limiting Control Setting, and Safety Limit. *Among the results the accident analysis should clearly establish are the limits shown in this figure.*

- Management, organizational, and institutional factors relied upon for safe operation;
- Operational safety basis and safety envelope parameters;
- Adequacy of the safety basis in terms of compliance with applicable nuclear safety rules and DOE requirements; and
- Commitments and the bases thereof to assure safe operation.

The accident analysis process sets the safety system design and performance expectations.

The accident analysis process sets the safety system design and performance expectations. These expectations arise from assumed conditions in the steps of each accident sequence. The expectations can be associated with such things as initial system conditions and assumptions regarding hardware system operating response time and system performance under adverse environmental conditions.

Some expectations become commitments.

Expectations that are essential to the validity of the accident analysis results become **commitments**. The realization of such expectations must be assured in order to maintain the validity of the accident analysis. The SAR must therefore present data so that personnel can understand clearly what must be done to maintain such commitments and what changes are required if an alternate safety commitment is contemplated.

2.15.11 Summary of Accident Analysis Results

An accident analysis must include a summary of the consequences and the likelihoods of occurrence for the scenarios analyzed. The summary must also include an assessment of the degree to which the facility conforms to all applicable evaluation guidelines.

Refer to figures 2.19 thru 2.21 to see examples of summaries for Hazard Category 3 facilities.

Figure 2.19 shows in truncated format, an example page from a SAR that summarizes the accident sequences analyzed for a Hazard Category 3 facility.

Figures 2.20 and 2.21 illustrate the kinds of radiological and toxicological guidelines that may be established for evaluating facility accident analysis results.

The effectiveness and appropriateness of the principal safety design criteria for the facility should be discussed in terms of the

Example page from a SAR showing an analysis of accident sequences.

Table 11-5. Analysis of GIF Accident Sequences

Sequence and Cause	Preventive Features	Method of Detection	Mitigation Features	Potential Impact and Risk Determination
I.A.1: Design Basis Earthquake Cause - Natural phenomenon resulting in a 0.22 g ground acceleration	Design - The GIF facility is located in a moderate seismic active zone with a probability of 1.0E-3 for an earthquake with 0.22 g ground acceleration. Administrative - None	- No detection or alarm devices are installed	Design - Building structure, cell walls and enclosure, source pool and other structures are designed to withstand a 0.22 g ground acceleration Administrative - The Title I and Title II design documents, as designed by outside contractor, are independently reviewed by an internal Sandia team and external review contractor (details in Chapter 18, Quality Assurance Program). - Operator will shutdown facility (lower all sources) upon detection of any ground movement.	Potential Impact - Safety-related features (cells, pool, and building) will survive this accident, and no radiation exposure is anticipated. - Damage may occur to non-safety related systems and equipment. Risk Determination Probability Level - Medium Consequence Level - Low Risk Level - Low
II.A.1: Airplane Crash Cause - Control malfunction, engine failure, loss of fuel, or pilot error resulting in the crash.	Design - The calculated probability for an plane crash into a TA-V facility is 7.5E-6 with the largest portion being general aviation (smaller airplanes). Administrative - None	- None	Design - GIF sources are normally stored the bottom of a 20 foot pool. - If sources are raised for irradiation they are contained in a 2 meter thick, reinforced concrete cell. Administrative - None	Potential Impact - Although a plane crash would cause serious damage to the facility and could be injurious to personnel, it is not likely that sources, pool or the cells would be significantly damaged. Risk Determination Probability Level - Low Consequence Level - Medium Risk Level - Low
II.B.1: TA-V Facilities - SPR Accident Cause - Accident at the Sandia Pulse Reactor which may adversely influence GIF operations.	Design - GIF is designed as a separate stand-alone facility that shares no structures with SPR. It shares the following utilities: electrical power, water, and liquid effluent treatment system. - SPR is 110 meters from GIF with the reactor located above ground in 1.4 meter thick concrete shield. - SPR external beam port is not in line with the GIF Highbay or Lowbay. Administrative - SPR hazardous experiments are normally performed out of hours.	- An audio alarm rings in all buildings and throughout TA-V.	Design - The TA-V fire/evacuation functions are integrated into a single area-wide alarm system. -Egress to evacuation assembly building is via outdoor route. Administrative - TA-V Emergency Plan requires all site workers to evacuate immediately on alarm to the predesignated assembly building unless prior exemption is granted. - Upon a fire/evacuation alarm during working hours, the GIF operator will shutdown (lower all sources) and proceed to evacuate.	Potential Impact - SPR is a Category 2 Nuclear Reactor Facility and has potential for significant on-site consequences. Risk Determination Probability Level - Med Consequence Level - Low Risk Level - Low
III.E.1.d: Administrative Failure Cause - Persons entering cell with source exposed.	Design - Interlock from cell radiation detector prevents opening the door when levels above one pin are detected. - Interlock from elevator drive prevents opening door if elevator not in down position. - Elevator tables are large and include many tapped holes for firmly mounting source support brackets. Administrative - Procedures require the Operator monitor the source ascension into the cell and decention out of the cell from the cell window. - All designs and modifications of source support brackets will be reviewed and approved by the Manager, Reactor Applications Dept. - All source transfers into support brackets will be monitored by the Health Physics Staff.	- A RAM located in line of sight of raised sources immediately outside of the door detects and alarms on abnormally high radiation levels as the door opens.	Design - When entering the GIF cells, operator and experimenters must wear chirpy that sound audible levels. Administrative - The shield door will be closed by the GIF Operator if any abnormally high radiation level is detected on the RAMs located outside of the cell door.	Potential Impact - Person in direct line of sight of unshielded source or entering a cell with a source/pin exposed will be in high radiation area. Depending on the time of expos-ure, this can result in high dose to lethal dose received Risk Determination Probability Level - Low Consequence Level - Medium Risk Level - Low

11-6

Figure 2.19. Example Page from a SAR Showing an Accident Analysis Summary. *This example is appropriate for summarizing the accident sequences for Hazard Category 3 facilities.*

RADIOLOGICAL SAFETY DECISION THRESHOLD CRITERIA*

Receptor	Annual Probability of Occurrence (P)			
	Normal Operation	$0.1>P\geq10^{-2}$	$10^{-2}>P\geq10^{-4}$	$10^{-4}>P\geq10^{-6}$
Off-site Individual	(Note 1)	0.5 rem	5 rem	25 rem
On-site Collocated Personnel	(Note 2) (Note 4)	5 rem	25 rem	100 rem
Facility Worker	(Note 3) (Note 4)	25 rem	100 rem	200 rem

* These safety thresholds do not imply that any exposure below the threshold value is acceptable without further consideration of the need for implementing preventive and/or mitigative measures for the purpose of keeping exposures ALARA. Whenever mitigated exposures exceed the criteria, adequate justification must be provided for any decision not to implement additional measures to reduce exposures below the threshold value.

Notes: 1. 0.1 rem/yr - annual EDE plus CEDE limit (DOE Order 5400.5)
0.01 rem/yr - annual airborne EDE limit (40 CFR 61 Subpart H) for releases other than radon

2. 5 rem/yr for certified radiological workers or trained visitors; otherwise, 0.1 rem/yr per the DOE Radiological Control Manual

3. 5 rem/yr if facility workers are certified radiological workers; otherwise, 0.1 rem/yr in non-radiologically controlled areas

4. In accordance with the SNL Radiation Control Manual, exceeding the SNL facility administrative limit of 1.5 rem/yr or the DOE administrative limit of 2.0 rem/yr requires prior approval by SNL management and the DOE Program Secretarial Officer (DP-1), or designee, respectively.

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This figure illustrates radiological safety decision threshold criteria.

Figure 2.20. Example Page from a SAR Showing Typical Radiological Safety Guidelines. *This figure shows the kinds of radiological data that may be established for evaluating facility accident analysis results.*

This figure illustrates typical toxicological safety decision threshold criteria.

TOXICOLOGICAL SAFETY DECISION THRESHOLD CRITERIA*

Receptor	Annual Probability of Occurrence (P)			
	Normal Operation (Note 1)	$0.1>P\geq10^{-2}$ (Note 2)	$10^{-2}>P\geq10^{-4}$ (Note 2)	$10^{-4}>P\geq10^{-6}$ (Note 2)
Off-site Individual	(Note 3)	0.1*ERPG-1	ERPG-1	ERPG-2
On-site Collocated Personnel	(Note 4)	ERPG-1	ERPG-2	ERPG-3
Facility Worker	PEL-TWA (Note 5)	ERPG-2	ERPG-3	2*ERPG-3

* These safety thresholds do not imply that any exposure below the threshold value is acceptable without further consideration of the need for implementing preventive and/or mitigative measures for the purpose of keeping exposures ALARA. Whenever mitigated exposures exceed the criteria, adequate justification must be provided for any decision not to implement additional measures to reduce exposures below the threshold value.

Notes: 1. Thresholds are defined for inhalation exposures. For multiple exposure pathways, thresholds may be defined using the EPA approach for defining a hazard index for multiple toxicants.

2. AIHA short-term exposure limits

3. Use EPA chemical-specific Reference Concentration, RfC (in $\mu g/m^3$), for non-carcinogenic effects and (7E-4)÷(Unit Risk) for carcinogenic effects; Unit Risk is an EPA chemical-specific cancer risk factor for inhalation exposures in units of $(\mu g/m^3)^{-1}$. This limit was derived based on the same lifetime excess cancer risk produced by a radiological exposure of 0.01 rem/year for 70 years.

4. Use EPA chemical-specific RfC for non-carcinogenic effects and (7E-3)÷(Unit Risk) for carcinogenic effects. This limit was derived based on the same lifetime excess cancer risk produced by a radiological exposure of 0.1 rem/year for 70 years.

5. Use TLV-TWA for the facility worker if PEL-TWA is not available.

11-8

Figure 2.21. Example Page from a SAR Showing Typical Toxicological Safety Guidelines. *This figure shows the typical kinds of toxicological data that may be established for evaluating facility accident analysis results.*

consequence limits, likelihood of occurrence limits, and risk limits that result from the accident analysis.

2.16 MANAGEMENT, ORGANIZATION, AND INSTITUTIONAL SAFETY PROVISIONS

2.16.1 Objectives

The writer's objectives for this SAR topic are to:

1. Identify the structures of those contractor organizations responsible for the design, construction, or operation (through decontamination and decommissioning) of the facility, and

2. Describe the way in which each organization handles facility safety issues.

2.16.2 Scope

The scope of subjects the SAR writer should cover in this topic are:

The writer must cover all these subjects for this SAR topic.

- Identification of the facility organizational structures;
- Mechanisms for coordination and communication of safety issue discovery, management, and resolution;
- Interfaces between dedicated facility organizations and organizations with external affiliations;
- Initiatives to promote team building and development of a safety culture;
- Mechanisms for independent review and appraisal of safety performance;
- Mechanisms for controlling changes to facility design, construction, and operations;
- Facility staffing and qualification guideline compliance; and
- Configuration management.

Details of the specific points to cover and the best subsection under which to present them are discussed below.

2.16.3 Presentation of Topic Subjects

Identification of the Facility Organizational Structures

In the introduction to this SAR topic, the writer should identify all organizations responsible for design, construction, or operation of the facility. This should include important background information and information such as organization charts.

Mechanisms for Coordination and Communication of Safety Issue Discovery, Management, and Resolution

Under this SAR subject, the writer should identify and explain:

- All mechanisms at the facility for coordination and communication of safety issue discovery, management, and resolution, and
- All organizational responsibilities and interfaces among subgroups responsible for specific aspects of safety. These include such aspects as engineering, procurement, construction, startup, operations, maintenance, quality assurance, compliance determination, personnel training, and procedure development).

Interfaces Between Dedicated Facility Organizations and Organizations With External Affiliations

Under this subject, the SAR writer should identify and explain the interfaces between dedicated facility organizations and organizations with affiliations outside the facility but involved in facility safety assurance (e.g., contract engineering services, emergency response organizations, etc.).

The information presented must be detailed enough for reviewers and decision makers to assess how effective contractor support organizations are in managing safety problems at the facility.

Initiatives to Promote Team Building and Development of a Safety Culture

Under this subject, the SAR writer should identify, explain, or summarize as appropriate:

- Initiatives that promote team-building;
- Initiatives to develop a safety culture/consciousness that encourages a questioning attitude among those having direct or indirect influence on facility safety;
- Mechanisms provided for independent review and appraisal of the safety performance of the facility and its team; and

- Safety-significant administrative controls and procedures

This last subject should be summarized in enough detail to allow decision makers reviewing the SAR to evaluate the strengths and weaknesses of the administrative checks and balances among the design, construction, and operations organizations.

Mechanisms for Controlling Changes to Facility Design, Construction, and Operations

Under this SAR subject, the writer should address:

- Mechanisms for controlling changes to the design, construction, or operation of the facility;
- Methods for selecting operating, surveillance, and maintenance plans;
- Facility configuration control and document control programs;
- Occurrence reporting (in accordance with DOE Order 5000.3A, *Occurrence Reporting and Processing of Operations Information*); and
- Operating experience review.

Facility Staffing and Qualifications Issues

Under this SAR subject, the writer should address various facility staffing and qualification issues including:

- Bases for minimum shift manning;
- Identification of required job knowledge, skills, and abilities;
- Bases for allocating operational, emergency response, and monitoring functions to on-shift and onsite positions versus on-call or intermittent positions;
- Bases for staffing levels and job candidate qualification requirements for safety-related operational positions;
- Fitness-for-duty requirements imposed on facility operations staff;
- Programs or provisions to monitor the performance of operations personnel; and

- Programs or provisions to enhance performance through mechanisms supplemental to normal line management and training provisions (e.g., team building and coaching).

2.17 PROCEDURES AND TRAINING

2.17.1 Objectives

Provide enough information on procedures and training at SNL facilities to show compliance with DOE 5480.20.

The writer's objectives for this SAR topic are:

1. To address the programmatic commitment to ongoing procedures and training programs considered to be a necessary part of safety assurance, and

2. To present sufficient information to show compliance with DOE 5480.20, *Personnel Selection, Qualification, Training, and Staffing at DOE Reactor and Non-reactor Nuclear Facilities.*

2.17.2 Scope

To meet the objectives, the writer should present summary descriptions of the facility procedures and training programs. These summaries should include brief discussions of the safety management policies and philosophies that form the foundation for these programs.

NOTE: Hazard Category 3 facilities are expected to have less rigor in their procedures and training programs. Consequently, the SAR would rely more on references to facility-specific activities. If a Hazard Category 3 facility has TSRs, the procedures and training for them must be specifically discussed in the same detail that would apply to a Hazard Category 2 facility.

Specific information for this SAR topic should cover the following subjects, if applicable:

- Selection, development, verification, and validation of facility procedures;

- Selection and development of technical content of personnel training programs;
- Identifying and correcting technical and human factors deficiencies in written procedures;
- Configuration control of procedures;
- Assurance that necessary training occurs prior to introducing new procedures or changes in the human-machine interface covered by procedures; and
- Compliance with the training requirements of DOE 5480.20.

2.17.3 Presentation of Topic Subjects

The writer must address all of the above subjects, if appropriate. Some specific points to cover are presented below.

NOTE: The information presented should be sufficiently detailed to enable decision makers reviewing the SAR to verify that the processes are adequate to produce and maintain technically appropriate procedures.

Selection, Development, Verification, and Validation of Facility Procedures.

The SAR writer should describe:

- All facility processes for selecting, developing, verifying, and validating the technical content of normal, abnormal, and emergency operating procedures, surveillance testing procedures, and maintenance procedures, and
- All processes by which the technical content of personnel training programs is selected and developed.

Identifying and Correcting Technical or Human Factors Deficiencies in Written Procedures.

The SAR writer should include a discussion of the mechanisms used to identify and correct any technical or human factors that lead to deficiencies in written procedures. An example of such a mechanism is the experience accumulated in training and qualification programs and in facility operations.

Configuration Control.

The SAR writer should describe facility provisions that assure that **adequate configuration control of procedures** and **necessary training** occur prior to introducing new procedures or changes in the human-machine interface covered by procedures.

Compliance with DOE Order 5480.20.

The SAR writer should provide sufficient information to convince reviewers and decision makers that the facility meets the requirements of DOE, 5480.20, *Personnel Selection, Qualification, Training, and Staffing at DOE Reactor and Non-reactor Nuclear Facilities.*

Specifically, to ensure compliance, this subject should cover:

- Initial and continuing training programs for normal, abnormal, and emergency operations;
- Organizational responsibilities for conduct of training and maintenance of training records; and
- Aspects of the training program such as
  - Methods for deriving program content,
  - Methods to accomplish training,
  - Qualification requirements for instructors,
  - Qualification requirements for operators, maintenance, and technical support personnel,
  - Certification requirements for positions,
  - Methods for analyzing/factoring operating experience into training programs, and
  - Methods for evaluating the effectiveness of training and improving its effectiveness through feedback.

2.18 HUMAN FACTORS

2.18.1 Objectives

Keep in mind that conclusions interpret results!

The writer's objective for this topic is to document the results and conclusions of a systematic inquiry into the optimization of the design of the human-machine interface intended to enhance reliable human performance at the facility under all operating conditions.

2.18.2 Scope

Human Factors centers around five major safety concerns.

Human Factors focuses primarily on five areas of safety concerns:

1. Allocation of control functions to personnel versus automatic devices;
2. Staffing and qualification of operating crews;
3. Personnel training;
4. Preparation, validation, and use of written procedures to guide operations, surveillance, and maintenance; and
5. Design of the human-machine interface to build on strengths and protect against the susceptibility to human error in operating crews.

The scope should include discussions on nine major subjects, based on a graded approach.

The scope should include, but not be limited to, the following, and presentations should apply a "graded approach" based on necessity:

- Description of the facility's Human Factors Program;
- Instrumentation, communication, and operational aids to support efficient performance;
- Design, layout, and labeling of facility controls and instrumentation;
- Design of the work environment;
- Onsite experience and training in mitigation of abnormal events;
- Human factors engineering problems;
- Human factors engineering deviations;
- Implications of human factors engineering deviations for contribution to human error in safety-related tasks; and
- Likelihood of human error contributing to a safety-related event.

The writer should address all these SAR topic subjects based on a graded approach. Details of the specific points to cover and the subsections under which best to present them are discussed below.

2.18.3 Description of the Facility's Human Factors Program

The writer's task is to summarize **briefly** the major aspects of the facility's Human Factors Program. Avoid unnecessary details.

2.18.4 Instrumentation, Communication, and Operational Aids to Support Efficient Performance

Describe only the instrumentation and controls used to identify or mitigate accidents or to monitor safety-related TSR parameters.

In this part of the SAR, the writer should describe the instrumentation, provisions for communications, and the operational aids that support timely/reliable performance of human operations important to safety. Also describe:

- Operations for restoring safety-related equipment after calibration, maintenance, tests, or other operations where equipment is temporarily removed from service;
- Provisions for recovery from restoration errors, such as self-checking and independent verification, or special control room displays; and
- Extent to which needed information is directly displayed in control rooms and in written materials to reduce information processing, interpretation, and decision making by control room staff during abnormal events.

2.18.5 Design, Layout, and Labeling of Facility Controls and Instrumentation

Demonstrate consistently reliable, safe performance.

Discuss the design, layout, and labeling of facility controls and instrumentation. The goal is to demonstrate consistency in reliable performance of those human activities of particular importance to facility safety.

2.18.6 Design of the Work Environment

Show that factors that can degrade worker reliability have been mitigated.

Show that factors that potentially can degrade the reliability of personnel to perform operations, maintenance, or surveillance tasks of special importance to facility safety have been minimized to the extent possible. Examples of such factors are physical access, need for protective clothing or breathing apparatus, noise levels, temperature, humidity, distractions, and other factors that bear upon physical comfort, alertness, fitness, etc.

2.18.7 Onsite Experience and Training in Mitigation of Abnormal Events

Show how facility personnel mitigate abnormal events.

For this subject, the writer should address the types and frequency of onsite practice and experience that operating personnel receive in mitigating abnormal events.

Also show how proper working relationships for coping with abnormal events are developed (e.g., the roles of specific individuals, the degree of supervisory authority, the establishment of communication links).

2.18.8 Human Factors Engineering Problems

Four major data sources are available for finding human performance problems.

The SAR writer should identify those data sources whereby human performance problems are identified. The four main data sources are:

1. Actual incidents where human performance either caused or contributed to a safety-related event;

2. Analyses of design basis accidents where human interaction in mitigation of the accident comes into play;

   NOTE: A part of the documentation of accident analysis assumptions must be a search for unquestioned premises regarding human performance. This is necessary to identify those situations where humans must take mitigating actions to protect the public. In these instances, human performance becomes part of the safety-class performance of the facility.

3. Evaluation of the human-machine interface design found in the facility for error potential; and

4. Analysis of tasks performed by facility personnel to identify those tasks with potential for human error leading to safety-related events.

2.18.9 Human Factors Engineering Deviations (HEDs)

HEDs are deviations from good human factors engineering design.

For this topic subject, the SAR writer should survey worker tasks to discover HEDs, which are deviations from good human factors engineering design. Discussion of this survey should be limited to those tasks for which the potential for safety-related human performance events is identified in the Accident Analysis section of the SAR.

See: MIL-STD-1472D, DOD-HDBK-761A, and UCRL-15673

The survey and identification of HEDs can be performed using design checklists. The use of an accepted human factors engineering design standard is essential (e.g., MIL-STD-1472D supplemented by DOD-HDBK-761A, and UCRL-15673). Also, complete a list of HEDs from *good design practices*, as defined by the standard.

2.18.10 Implications of Human Factors Engineering Deviations for Contribution of Human Error in Safety-Related Tasks

Apply the graded approach to sections 2.18.10.1, 2.18.10.2, and 2.18.10.3.

The writer should break down information presented for this SAR topic into three subordinate subjects based on a graded approach as follows:

- DOE operating experience;
- Human interaction in mitigating design basis accidents (DBAs); and
- Human-machine interface design.

2.18.10.1 DOE Operating Experience

Here, the SAR writer needs to present an evaluation of DOE operating experience throughout the DOE complex.

Data can be sought from the ORPS and SPMS.

Data for this task can be obtained from the DOE Occurrence Reporting and Processing System (ORPS) and the Safety Performance Measurement System (SPMS). Data search for this task should scan

several years, and for operating facilities should scan a significant period of time when the facility was operating.

2.18.10.2 Human Interaction in Mitigating DBAs

Each DBA has an emergency procedure for mitigation.

The SAR writer needs to reference each DBA to an emergency procedure which directs human responses. This human interaction subject should include an evaluation of the task analysis that provides the basis for the emergency procedure, as well as of the performance section of the procedure itself.

Preparers and writers of the SAR should focus this evaluation on identifying errors that might be committed in any of the required actions. For example, the following errors might be identified:

Possible errors

- Omission of an action;
- Commission of an action (e.g., acting on the wrong control or doing something different from what is needed); and/or
- Untimely action (e.g., acting too slowly).

Evaluate the potential for the above errors to occur in light of the human factors engineering design criteria for items such as:

- Specific instrumentation and controls provided to aid human performance tasks;
- Placement of instrumentation and controls;
- Information presentation; and
- Equipment labeling.

2.18.10.3 Human-Machine Interface Design

Focus on deviations from design and the risks of tasks that use machines.

For each deviation from standard design criteria, present in this subsection the results/conclusions of a risk analysis on each task that uses a machine. If human error can lead to a safety-related event, the human factors problem should be analyzed further to determine the risk factors.

NOTE: Remember that conclusions are not results, but are interpretations of results!

2.18.11 Likelihood of Human Error Contributions to Safety-Related Events

Describe the HRAs and the resultant task/equipment priorities.

In this subsection, the SAR writer should present the results/conclusions of human reliability analyses (HRAs). These HRAs should be performed for those tasks identified as having potential for human error that can result in severe consequences.

2.19 INITIAL TESTING, INSERVICE SURVEILLANCE, AND MAINTENANCE

2.19.1 Objectives

This topic must show that the facility is committed to initial and inservice testing, surveillance, and maintenance.

The SAR writer's objective for this topic is to demonstrate to SAR reviewers and decision makers that the facility has a programmatic commitment to initial testing, surveillance, and maintenance programs as an integral part of safety assurance.

2.19.2 Scope

The topic content consists of the following:

- Facility initial testing, inspection, and operational readiness review program;
- Facility program for inservice surveillance; and
- Facility program for planned, preventive, predictive, and corrective maintenance.

NOTE: Hazard Category 3 facilities have potential only for significant localized consequences. Thus, the discussion of initial testing, in-service surveillance, and maintenance should be limited to the extent that the facility includes safety-significant SSCs requiring a support program to assure their functionality.

2.19.3 Facility Initial Testing, Inspection, and Operational Readiness Review Program

Describe this program and explain how it works for the safety and good of the facility.

For this topic subject, the SAR writer should:

- Describe the facility initial testing, inspection, and operational readiness review program.
- Explain how the program is applied for new facilities or major modifications to existing facilities.
- Explain how the program ensures that the design safety specifications for safety-class SSCs are met and that the facility (new or modified) is ready to start operating.
- Address the adequacy of testing provisions, the testing scope, and the frequency and timing of tests in the context of the provisions and capabilities for doing maintenance and repair work at the facility.

2.19.4 Facility Program for Inservice Surveillance

For this SAR topic subject, the writer should describe the Surveillance Test Program and how it provides realistic validation of the performance of safety functions under accident conditions. Also describe or explain:

- Testing and calibration of instrumentation;
- Control and calibration of test equipment to NIST standards;

Describe/explain these program aspects.

- Test and calibration procedures;
- Trending of surveillance test results; and
- Training of personnel performing surveillance.

2.19.5 Facility Program for Planned, Preventive, Predictive, and Corrective Maintenance

For this SAR topic subject, the writer should describe the graded maintenance work-control system for planned, preventive, predictive, and corrective maintenance activities. Be specific enough to assure decision makers that adequate maintenance activities exist to support facility safety management, but generic enough to allow for revisions to the program with minimal revisions to the SAR.

Specifically address the following:

- Maintenance philosophy, objectives, and organization;
- Responsibilities for specific maintenance functions;
- Interfaces with other organizations;
- SSCs and equipment covered by the maintenance program;
- Training of maintenance personnel;
- Maintenance procedures;
- Post-maintenance testing;
- Control and calibration of measuring equipment;
- Maintenance history and trending;
- Maintenance facilities and equipment;
- Analysis of maintenance problems;
- The work modification process;
- Limitations imposed by design and operations on routine maintenance/repair activities related to facility safety; and
- Provisions or compensatory actions developed to prevent the above limitations from degrading facility safety.

Provide write-ups on these graded-maintenance work control system for corrective action maintenance.

2.20 DERIVATION OF TECHNICAL SAFETY REQUIREMENTS

TSRs are derived from facility-specific safety analyses.

Technical Safety Requirements (TSRs) are derived from facility-specific safety analyses. This analysis should reveal two important segments of information:

1. The operational limits necessary to ensure the facility's operation as assumed in the analysis, and

2. The parameters and operating conditions that must be limited to reduce hazardous emissions, provide warning of emissions, mitigate uncontrolled releases of hazardous materials, and prevent inadvertent criticality events.

2.20.1 Objectives

The writer's objectives for this SAR topic are:

See DOE 5480.22.

1. Provide SAR reviewers and decision makers with the logical basis for the comprehensive definition of an acceptable **operating envelope** for the facility in accordance with DOE Order 5480.22, *Technical Safety Requirements.*

2. Address all facility safety envelope modes of operation and all tests and experiments for which DOE authorization is sought.

3. Clearly document the basis for safety limits, limiting safety system settings, limiting control settings, limiting conditions for operation, and all surveillance requirements for the facility.

4. Provide a link between the accident analysis and the TSR document.

2.20.2 Scope

The information presented must document safety limits, limiting safety system settings, limiting control settings, limiting conditions for operation, and all surveillance requirements for the facility. The

information presented must provide sufficient information to describe the facility's operation envelope and demonstrate the safety acceptability of the following:

- Modes of operation, including abnormal and emergency operation, maintenance, and surveillance testing;
- Established operating parameter set points and limits;
- Minimum operable equipment requirements;
- Staffing and qualification requirements of operating crews; and
- Other administrative safety controls.

The SAR writer may address the above scope in subsections such as those that follow or in alternate ways explained in these subsections.

These headings for 2.20.3 and 2.20.4 are examples. Specific headings for comparable subsections should be based on the specific subjects stated in the SAR being prepared.

2.20.3 Technical Basis and Methods for Deriving the TSR

Include in the discussion of the technical bases for the TSRs a list of the accident scenarios described in the Accident Analysis topic of the SAR. Reference those sections of the Accident Analysis where requirements are established for defining the safe operating envelope.

2.20.4 Commitments and Administrative Controls

Commitments to establish, maintain, and implement programs that support safe facility operations will be included in the Administrative Controls section of the TSR document. This topic should provide a link to the appropriate SAR chapter or to the section that describes each of these programs.

2.20.5 Optional Approaches to Presentation of Data

The way TSR derivation data are displayed depends on the complexity of the facility or operations involved.

For simple facilities or small operations, the required information may be included in the text of this topic.

For larger or more complicated facilities, a tabular format like that shown in Figure 2.22 on the following page may be used along with references to specific sections of the SAR where more detailed

information can be found. Figure 2.23 shows an example page on this topic from a SAR.

For large complicated facilities, a tabular format such as the one used in this figure may be used along with references to SAR sections where details are contained on the subject.

ACCIDENT: EARTHQUAKE
SYSTEM: Glovebox/Hoods/Laboratories

SAFETY CLASS ITEMS	OPERATING MODE	LIMITATIONS/SURVEILLANCE REQUIREMENTS	BASIS	SAFETY ANALYSIS SECTION
Building (Passive SCI)	OPERATION /WARM STANDBY	The building is required to maintain its integrity to preclude failure of stored containers for this event.	The building must be designed to withstand the effects of the event for which it is required.	9.1
	OPERATION /WARM STANDBY	LCO - Process limits on radioactive material allowed.	Radioactive material limit was an assumption made in the safety analysis.	9.2.4
Glove Box Off-Gas	OPERATION /WARM STANDBY	The Glove Box Off-Gas can't fail adversely. Bldg vent/sec. containment systems are required. Surveillance Requirements - Perform functional test on system. Surveillance Frequency - Semi-annually	During operations within this system and during warm standby, the primary and secondary containment systems (e.g., fans, structures, diesel generators, electrical support, etc.) must be capable of providing containment to mitigate the consequences of an accident. These systems must be designed to withstand the effects of the event for which they are required. Surveillance Interval is based on ANSI Standard.	9.3.2

STAFFING REQUIREMENTS: Three facility operators for four hours on a semi-annual basis to perform the surveillance.

14-1

Figure 2.22. Example of a Tabular Format for Presenting Derivation of TSR Data. *The data seen in this figure are displayed in a tabular format because they represent a large or complicated facility or operations.*

This example page from a PSAR shows the kinds of information that should be provided regarding the derivation of TSRs.

16.0 DERIVATION OF TECHNICAL SAFETY REQUIREMENTS

This chapter describes the basis for establishing the operational safety envelope for the GIF. The purpose is to serve as a logical link between the accident analysis in Chapter 11 and operational limits to be presented in the GIF Technical Safety Requirement (TSR) document.

Because this document is a Preliminary Safety Analysis Report, the descriptions, discussions, and commitments made in this chapter are preliminary in nature. Updated, detailed descriptions of the derivation of TSRs for the GIF will be forthcoming in the FSAR.

16.1 METHODOLOGY FOR BASIS DEVELOPMENT

The process for developing a TSR basis involves an examination of the accident analysis to determine the design and performance expectations that have been established by the analysis. Expectations that are vital to the validity of the analysis are commitments that must be translated into TSRs. The following aspects of the safety analysis have been examined to identify any expectations that are relied upon for assurance of safety at the GIF:

- Engineered safety features
- Accident analysis summary
- Basis for normal/abnormal operations
- Administrative controls

16.2 SAFETY BASIS

16.2.1 Engineered Safety Features

Table 16-1. Engineered Safety Features (ESF) for the GIF

ESF	Safety Function	Function Type
Source Cladding	Containment of Radioactive Material	Passive
Pool of Water	Radiation Shielding	Passive
Irradiation Cell Shield	Radiation Shielding	Passive
Elevator Power Interrupt	Cell Access Control	Active
Radiation Monitoring System	Detection of Radiation Conditions	Active

14-2

Figure 2.23. Example Page from A PSAR Addressing the Derivation of TSRs. *This figure shows the kind of discussion that is appropriate in addressing how TSRs for a facility or operation are to be derived.*

2.21 OPERATIONAL SAFETY

2.21.1 Objectives

The writer's objectives for this SAR topic are to:

1. Address the bases for the programs, plans, and procedures used to assure that facility activities are organized, managed, and conducted safely in accordance with DOE Order 5480.19 and other applicable DOE directives, and

2. Show compliance with the "safe storage and criticality safety" requirements for special nuclear materials stored in the facility.

2.21.2 Scope

The scope for this topic should encompass the following subjects:

- Facility safety politics and performance standards;
- Operations organization and administration;
- Shift routines and operating and turnover practices;
- Controlled area activities;
- Communications within the facility;
- Control of on-shift training;
- Investigation of abnormal events and reporting practices;
- Control of equipment and system status;
- Independent verification practices;
- Development/control of operating procedures and manuals;

Ensure reviewers that all aspects of Operational Safety are adequately covered by reporting on all these subjects.

- Hazardous materials control and fire protection programs; and
- Safe storage and criticality safety requirements.

2.21.3 Contents and Development of the Topic Sections

As a minimum, the 12 scope subjects should cover the following:

- **Facility Safety Policies and Performance Standards:** Identify and explain those facility safety policies and performance standards adopted by the facility operating organization.
- **Operations Organization and Administration:** Self explanatory.
- **Shift Routines and Operating and Turnover Practices:** Focus on those aspects that enhance facility safety.
- **Controlled Area Activities:** Focus on those aspects that support safe and efficient operations.

Cover each of these subjects sufficiently so that reviewers and decision makers gain full appreciation of the effectiveness of operational safety at the facility.

- **Communications within the Facility:** Focus on the procedures and practices that promote audible facility communications.
- **Control of On-Shift Training:** Include operator training programs in this discussion.
- **Investigation of Abnormal Events and Reporting Practices:** Focus on programs for investigating and reporting **abnormal** events.
- **Control of Equipment and Systems Status:** Focus on programs to control facility equipment and systems status.
- **Independent Facility Verification Practices:** Self explanatory.

- **Development and Control of Operating Procedures and Manuals**: Focus on the development, approval, use, and control of operating procedures and manuals for normal and emergency operations.

- **Hazardous Materials Control and Fire Protection Programs**: Provide enough detail to verify the safety sufficiency of provisions for the control of chemical risks associated with the operation, maintenance, surveillance, and emergency response at the facility.

- **Safe Storage and Criticality Safety Requirements**: Address the program to ensure compliance with the safe storage and criticality safety requirements for special nuclear materials stored within the facility under the terms of the facility's authorization to operate.

Figure 2.24 shows an example page from a SAR on this topic.

2.22 QUALITY ASSURANCE

2.22.1 Objectives

See DOE 5700.6C.

The writer's objective for this topic is to present sufficient information to show compliance with DOE Order 5700.6C, *Quality Assurance.*

2.22.2 Scope

SAR preparers should address those aspects of the site/facility Quality Assurance Program (QAP) directly relating to ensuring safety/quality of facility operations. The scope should include the following:

- Organization;

- Management QA policies;

- Methods to determine the safety-related work, processes, and SSCs requiring QA control;

This example page shows only a portion of one of the specified scope subjects the writer must address for this SAR topic, but reflects typical Operational Safety information.

17.0 OPERATIONAL SAFETY

This chapter presents general organizational, procedural, and administrative information concerning operation of the Annular Core Research Reactor, including basic organization structure and responsibilities, operational training programs, development and use of written procedures, maintenance of records pertinent to reactor operations, procedures for review and audit, and emergency plans.

17.1 ORGANIZATION AND RESPONSIBILITY

This section presents the general management and organizational structure employed in the administration of reactor operations. General assignment of responsibilities for the operational organization and safety support groups is also presented.

17.1.1 General Organization

The general management organization shown in Figure 17.1-1 identifies the line organization (i.e. chain of command). The President of Sandia National Laboratories has the prime responsibility for the administration of reactor operations. This responsibility includes establishment of functional lines of responsibility and delegation of authority, ensuring that methods exist for establishing an operational staff with well-defined responsibility and authority. Procedures exist which establish mechanisms for developing approved administrative controls and for assuring compliance with the terms of the nuclear reactor safety clause.

The Manager, Facilities Operations, is responsible for ensuring the conduct of nuclear operations at Technical Area V is within the applicable DOE and SNL directives and regulations. The Manager is a member of the Reactor Engineering Technology Center staff and reports directly to the Center Director. Within the Center, there are three departments directly associated with the nuclear operations. These are the Reactor Applications Department, the Radiation Physics and Hot Cell Applications Department, and the Nuclear Facility Safety and Development Department.

The Reactor Applications Department is assigned the responsibility for the conduct of operation of the reactors, and the Nuclear Facility Safety and Development Department is responsible for providing both administrative and technical support for conduct of reactor operations.

17.1.2 Safety Responsibility

Nuclear reactor safety responsibility is set forth in the Nuclear Reactor Safety clause of the Sandia contract which states that ....

17-1

Figure 2.24. Example Page from a SAR Showing Typical Operational Safety Information. *This page presents typical*

The topic subjects focus on the facility management's programs for assuring 1) the conduct of activities having the potential to impact safety, and 2) the acceptability of safety-class and safety-significant SSCs.

- Program to achieve continuous improvement;
- QA administrative technical implementing documents;
- Program for facility personnel qualification and training;
- Program for document control and records management;
- Program for management control of work assignments; and
- Programs for internal and external management assessment.

NOTE: The writer should stress to the SAR reviewer/decision maker the facility's compliance with DOE Order 5700.6C, *Quality Assurance*.

2.22.3 Contents and Development of the Topic Sections

- **Organization**: Identify the safety/QA organizational structure, functional responsibilities, and interfaces to assure implementation of facility management's programs.

Cover each of the subjects for this SAR topic sufficiently such that reviewers and decision makers gain a full appreciation of the effectiveness of the QAP for the facility.

- **Management QA Polices**: Give an overview of facility management's policy and/or approach to achieving and assuring safety and quality of operations.
- **Methods to Determine Safety-Related Work, Processes, and SSCs Requiring QA Control**: Describe the methods used to determine the safety-related work, processes, and SSCs to be controlled in accordance with QAP requirements.

- **Program to Achieve Continuous Improvement**: Include the processes for detecting and documenting failures and nonconformances and for identifying, analyzing, resolving, and following up on recurring programmatic and technical problems.

- **Applicable QA Administrative Technical Implementing Documents**: Include also:

  - Controls for using and calibrating tools, gages, instruments, and other measuring/test equipment needed in activities affecting quality;

  - Procedures for verifying conformance of items or activities to specified safety or quality requirements, including controls for notification, documentation, evaluation, and disposition of identified nonconformances;

  - Controls to prevent damage or loss and to minimize deterioration of items during handling, storage, cleaning, packaging, shipping, and preservation activities; and

  - Procedures for documenting corrective action plans, status tracking, and implementation verification of identified conditions adverse to safety or quality.

- **Program for Facility Personnel Qualification and Training**: Provide an overview of this program to assure that suitable proficiency is achieved and maintained for personnel performing activities affecting safety.

- **Program for Document Control and Records Management Program**: Describe this program briefly, including measures for controlling the preparation, review, approval, issuance, use, and revision of documents that either specify safety/quality requirements or prescribe activities affecting safety or quality.

- **Program for Management Control of Work Assignments**: In describing this program include design, procurement, and acceptance inspection and testing.

- **Programs for Internal and External Management Assessment**: Focus this presentation on those programs for verifying compliance with all aspects of the QAP and for determining its effectiveness, including documentation, reporting, and dispositioning of audit results.

2.23 EMERGENCY PREPAREDNESS

2.23.1 Objectives

Provide sufficient information to prove facility compliance with DOE Orders 5500.1B, 5500.2B, and 5500.3A

The writer's objective for this topic is to provide write-ups/descriptions complete enough to prove to SAR reviewers and decision makers facility compliance to the following DOE Orders:

- 5500.1B, *Emergency Management System;*

- 5500.2B, *Emergency Categories, Classes, and Notification and Reporting Requirements*; and

- 5500.3A, *Planning and Preparedness for Operational Emergencies.*

2.23.2 Scope

Preparers and writers should cover in the scope of the write-ups/ descriptions for this SAR topic the following subjects as a minimum:

- Philosophy, objectives, and organization of the emergency preparedness functions, and

- Activation of emergency response.

2.23.3 Contents of Topic Subsections

Hazard Category 3 facilities should not need extensive emergency response.

The topic subjects should be organized into subsections and entitled appropriately to reflect DOE Order guidelines and SAR scope. Based on the scope above, the writer must address the philosophy, objectives, and organization of the emergency preparedness functions. The information presented must include:

- An applicable spectrum of emergencies (ranging from local area emergencies to those that could affect persons offsite), and
- Activation of emergency response organizations, assessment actions, notification processes, emergency facilities and equipment, training and exercises, and recovery actions.

NOTE: Hazard Category 3 facilities should not require extensive emergency response since they do not present a significant onsite or offsite hazard. However, responses to emergencies from adjacent facilities should be addressed, if the subject facility is affected by accidents within adjacent facilities and an appropriate emergency response is not already adequately covered in the adjacent facility SARs. In addition, emergency plans for in-facility emergencies should be discussed.

Figure 2.25 on the following page shows a page from a SAR giving information typical for this topic. The information presented in this figure covers only one aspect (Emergency Classification and Emergency Action Levels) of the Emergency Preparedness topic.

19.0 EMERGENCY PREPAREDNESS

This chapter captures the essence of the Sandia/NM emergency preparedness program, the details of which are contained in the Emergency Preparedness Plan for Sandia National Laboratories (EPP, 1991).

19.1 EMERGENCY CLASSIFICATION AND EMERGENCY ACTION LEVELS

Department of Energy Orders list three categories of emergencies: Operational Emergency, Energy Emergency, and Continuity of Government Emergency. This chapter will address only those conditions listed in the Operational Emergency category. The Energy Emergency and Continuity of Government emergency categories are outside the scope of the Sandia/NM Emergency Plan.

Operational Emergencies are significant accident, incidents, events, or natural phenomena that have the potential to seriously degrade the safety or security of DOE facilities. Operational Emergencies apply to: DOE reactors and other DOE facilities (nuclear and nonnuclear) involved with hazardous materials; DOE-controlled nuclear weapons, components, or test devices; DOE safeguards and security events; and transportation accidents involving hazardous material.

In this typical presentation of SAR topic data, the Emergency Classification and Emergency Action Levels subject is designed to meet the requirements of DOE Order 5000.3B.

The three classes of Operational Emergencies, listed in order of increasing severity, are Alert, Site Area Emergency, and General Emergency. These classes are differentiated by severity in order to specify appropriate emergency actions, including required response activities and notifications commensurate with the degree of hazard the event presents. These emergencies, plus less severe events categorized at the "unusual" or "off normal" level, must be reported as required by DOE Order 5000.3B.

The Operational Emergency category is divided into five response areas: (1) reactors; (2) nonreactor facilities; (3) nuclear weapons, components, and test devices; (4) safeguards and security; and (5) transportation.

This chapter addresses the event clarification system and includes the post-event conditions of recovery and termination. Emergency Action Levels (EALs) are defined and explained in Section 6.1.3.

19.1.1 Emergency Classification

A key element in the identification, mitigation, and recovery from any emergency is a classification system that identifies the severity of the event and provides a minimum level of response guidance. The identification of the event severity in common terminology will aid in the mutual understanding of the problem or potential problem when communication with on-site responders and off-site agencies.

The event classification for the system that has been developed and is in use at DOE facilities are: Alert, Site Area Emergency, and General Emergency. The ....

19-1

Figure 2.25. Example Page from a SAR Showing Typical Emergency Preparedness Topic Information. *This figure illustrates only one kind of topical facility emergency preparedness information that decision makers look for in their review of the SAR.*

2.24 PROVISIONS FOR DECONTAMINATION AND DECOMMISSIONING (D&D)

2.24.1 Objectives

See DOE Orders 5400.3 and 5820.2A.

The writer's objectives for this topic are to furnish SAR reviewers and decision makers with:

1. Topic information on D&D issues that influence design, construction, and operation of the facility, and

2. Topic information comprehensive enough to prove facility compliance with:

   - DOE Order 5400.3, *Hazardous and Radioactive Mixed Waste Program*, and

   - DOE Order 5820.2A, *Radioactive Waste Management.*

NOTE: For Hazard Category 3 facilities, an extensive D&D chapter should not be required because the unmitigated hazard of the original facility or operation is not significant to worker or public health. A summary reference to a D&D plan will suffice.

2.24.2 Scope

Cover only new facilities or major modification to existing facilities, not ongoing facilities unless major modifications are to be performed.

The scope subject matter must cover:

- Issues that influence design, construction, and operation of the facility, and

- Conceptual plans for decontamination and ultimate decommissioning of the facility.

These issues and plans should show decision makers that the **planning of facility operations** and the **evaluation of vulnerabilities to a spectrum of events** (including accidents) include the means to :

- Minimize any site and environmental contamination that would complicate decommissioning or otherwise limit the ultimate effectiveness of environmental restoration, and
- Prevent an increase in residual risks during or after decommissioning.

To furnish sufficient information to ensure compliance to DOE Orders 5400.3 and 5820.2A, the SAR writer should take care to include descriptions and information on:

- Structural and internal features that will facilitate facility D&D, and
- Process for managing radiological and hazardous waste materials generated during D&D.

2.24.3 Contents of Topic Subsections

The topic subjects for this chapter of the SAR should be organized into subsections and entitled appropriately to reflect DOE Order guidelines and SAR objectives and scope.

2.25 APPENDICES

2.25.1 Objectives

Detailed information (e.g., calculations, data sets, graphs, and records) should be presented in various appendices in the SAR.

The SAR writer's objective is to make sure that information that is overly detailed is not placed in the main body of the SAR but rather in appendices at the end of the SAR.

NOTE: Too much detail can disrupt an orderly review process. An over- abundance of detail causes readers to lose focus by becoming entangled in complicated data that may be difficult to assimilate.

2.25.2 Scope

Overly detailed material the writer wants to include in the SAR should be placed in an appendix or in individual appendices at the end of the SAR. Examples of such materials include but are not limited to:

- Information regarding analytical models;
- Calculations/calculational methods;
- Graphs;
- Data sets;
- Lists of definitions;
- Complex readings and records; and
- Reports furnished by others.

2.25.3 Format for Appendices

Appendices formats often vary. Each individual appendix placed at the end of a SAR should have as a minimum:

- Title page with descriptive title, and
- Any other identifying information considered important.

NOTE: Examples of placing overly detailed information in appendices rather than in the body of the document are Appendices A, B, and C found at the end of this style guide.

CHAPTER 3

PUBLICATION GUIDELINES FOR SNL SAFETY ANALYSIS REPORTS

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CHAPTER 3: PUBLICATION GUIDELINES FOR SNL SAFETY ANALYSIS REPORTS

3.1 INTRODUCTION

Chapter 3 provides guidance to writers concerning publishing Sandia facility SARs.

This chapter of the style guide presents the general guidelines for the publishing of Sandia facility SARs. The final ingredient that preparers and writers must consider in the SAR preparation effort is to ensure that the SAR issued meets the highest possible standards for publishing documents.

NOTE: The official guide to be used for publishing SNL SARs is SAND89-0996, *Guide to Preparing and Processing SAND Reports*.

3.2 OBJECTIVES

The objectives of this chapter of the style guide are to:

1. Provide guidelines for publishing SARs, and
2. Ensure the final document meets the highest possible state-of-the-art quality expected for published SAR documents.

3.3 SCOPE

The scope of the publishing guidelines encompasses:

- Paper stock;
- Report covers;
- Graphic illustrations;
- Section numbering and style;
- Page numbering;
- Grammar;
- Abbreviations, acronyms, and glossary terms;
- References;
- Draft copies; and
- Final copies.

3.4 PAPER STOCK

Use only white paper and print only with black ink for the final SAR.

3.5 REPORT COVERS

For front and back covers, use 65-pound cover stock. Use only black ink for printing on the front cover.

3.6 GRAPHIC ILLUSTRATIONS

Use artwork to make the SAR presentation more effective.

Artwork is very effective in supporting the text messages. Use drawings, maps, diagrams, sketches, and tables to support text when the artwork would make the text more effective.

Make certain the artwork being presented (figures, tables, etc.) meets the following criteria:

- Reproductions are in black on white for easy reproducibility;
- Title is at the bottom for figures, or at the top for tables;
- Figure/table number designators use decimals;
- Information presented is legible;
- Symbols used are defined;
- Dimensions used are to appropriate scale;
- References are appropriate; and
- Design and presentation of information can stand alone.

Ensure each piece of artwork meets these criteria.

Figure criteria.

Place the figure titles at the bottom of the figure. Number the figures sequentially (using decimal system) within each individual chapter. For example, the fifth figure to appear in chapter 3 would be Figure 3.5.

Table criteria.

Place table titles above the tables. Number the tables sequentially (using decimal system) within each individual chapter. For example the first table to appear in chapter 2 would be Table 2.1. Capitalize the first letter of the first word, all main words, and the first letter of the last word of the table title.

Reference artwork in the text.

Place the artwork within the section where it is first referenced. However, a figure/table/etc. simply referenced and left to its own is not effective. Do NOT simply reference the artwork. Artwork must be "connected" to the text to be effective.

Establish a connection between the text and the artwork.

Design each piece of artwork to **stand alone**, although it must be placed strategically to support the text, and the text message must be written to support the artwork. Thus, the SAR writer must make certain to use the necessary language in the text and in the figure/table *captions* to "connect" each piece of artwork to the text message, and the text message to the artwork.

To establish a connection for the SAR reviewer between the artwork presented and the text message:

- Write into the text a sentence or paragraph explaining what the referenced figure/table/etc. is about.
- Add an *italicized* informative caption after the title of the figure/table/etc.

NOTE: See the figures presented in this style guide for examples. Each contains a figure number, title, and explanatory caption.

3.7 SECTIONS/SUBSECTIONS NUMBERING AND STYLE

Use the decimal system to identify each section/ subsection.

Number each section/subsection of the SAR. Use the decimal system to indicate the levels of subordination.

Use ALL CAPITAL LETTERING for **X.0** and **X.X** headings and subheadings. For the **X.X.X** subheadings, capitalize only the first letter of the first work, all main words, and the first letter of the last word.

NOTE: This style guide follows this principle.

3.8 FORMAT FOR SECTIONS

Formatting the SAR sections requires use of word processing computer software.

Formatting for the SAR involves several important points requiring computer software word processing functions:

- Use block formatting for the SAR sections, subsections, etc.
- Use double spacing between paragraphs and single spacing within paragraphs.
- Use *serif* type for the body of the text in the document.
- Use *sans-serif* type for the cover page, individual title pages, and **X.0** and **X.X** headings.
- Use appropriate font sizes for title page information.
- Use 14-point or larger font size for chapter title.
- Use 12-point font size for section headings and section text.

NOTE: Also see Section 3.15 and 3.16 for additional requirements that require computer software word processing formatting.

3.9 PAGE NUMBERING

Preliminary pages.

Number the Table of Contents, List of Tables, List of Figures, and glossary-type pages sequentially with small Roman numerals. Center the page numbers and position them 1/2 inch from the bottom of the page.

Body of report.

Also number all chapters and appendices individually, and place the page numbers 1/2 inch from the bottom center of the pages. For example, page 4 of chapter 3 would be numbered 3-4. Page 1 of Appendix B would be numbered B-1.

Odd - and even-numbered pages.

Make the first page of each preliminary section (e.g., Table of Contents), chapter, and appendix of the SAR an odd-numbered page. Any blank pages inserted to achieve this should be numbered at the bottom center of the page, and the words "Intentionally left blank" should appear centered on the even-numbered page.

Also, odd-numbered pages must be the front side of a page. Even-numbered pages must be the back side of a page.

3.10 GRAMMAR

For English grammar and style of presentation, see the Shipley Associates Style Guide.

An acceptable guide for English grammar is:

> Freeman, Lawrence H. and Bacon, Terry R. *Shipley Associates Style Guide*. Revised ed., reprinted 1992. International Standard Book No. 0-933427-22-0. Shipley Associates.

The *Shipley Associates Style Guide* is a comprehensive style guide containing state-of-the-art information on all conceivable concerns that preparers and writers of SARs may have on use of English grammar and style of document presentation. This guide also lists other published standard guidebooks that may be consulted for instructions.

This style guide may be obtained from:

Shipley Style Guide address.

> Shipley Associates
> P.O. Box 480
> Bountiful, UT 84011

Another acceptable guide is:

> *Gregg Reference Manual*. William A. Sabin, Ed., McGraw-Hill Publishers.

3.11 ABBREVIATIONS, ACRONYMS, AND GLOSSARY TERMS

Criteria depend on the subject and conventions.

The criteria to be followed depend on the subject matter and accepted conventions. For example:

- Capitalize all proper nouns, except when professional conventions dictate otherwise.
- Follow U.S. Geological Survey (USGS) conventions for geological terms.
- Follow American Physics Society (APS) conventions for physics terms.

- Follow conventions of the various engineering societies for engineering terms.
- Spell out the term/acronym the first time it is used, then follow with the term/acronym in parentheses.
- Refer to the *Glossary of Technical Terms* in the preliminary pages of this SAR style guide.

Two documents that preparers and writers of SARs may find useful for referencing in the SAR are:

- SAND89-0217, *Acronyms, Initialisms, and Abbreviations*
- SAND92-0192, *Environment, Safety and Health Glossary*

3.12 MEASUREMENTS

Writers of SARs must make the necessary effort to ensure that the style of using measurements in the text and illustrations is correctly and consistently applied. Measurement style that is inconsistently applied throughout the SAR will distract the reviewer. Inconsistent style may create the impression that other data and parts of the SAR are inconsistent and perhaps not entirely correct.

See the Shipley Associates Style Guide for detailed instructions on correct use of measurements.

Consult the *Shipley Associates Style Guide* for a detailed presentation of use of measurements in reports. Generally, adhere to the following to ensure correct and consistent use of measurements style:

- Use metric units followed by English units in parentheses throughout text.
- Abbreviate when appropriate and use proper style for abbreviations.
- Be consistent in use of abbreviations (if abbreviations are used in one section use them in all sections).

NOTE: The *Shipley Associates Style Guide* referenced in Section 3.10 above contains detailed guidelines on the state-of-the-art style for using and abbreviating measurements.

3.13 REFERENCES

Place the references that support the SAR chapter text in a list at the end of each SAR chapter to which they belong.

3.14 DUPLICATION OF INFORMATION

Avoid duplication.

Avoid duplication of information whenever possible. Information required in multiple sections of a SAR should be presented only in the most appropriate section of the document, then referenced appropriately in all other sections.

3.15 DRAFT COPIES

Submit 10 copies.

To facilitate the review process, drafts of the SARs must be printed double-sided and be line-numbered on the left side of the page. Page/text dimensions are the same for final copies (see Section 3.16 below). Submit 10 copies of all drafts for review to:

Sandia National Laboratories
Risk Management and NEPA Department
P.O. Box 5800, MS 1037
Albuquerque, NM 87185-1037

No logos in the document!

No contractor logos or information on which company prepared the document shall appear anywhere in the document, except for the cover page.

3.16 FINAL COPIES

Along with publication-quality copies of the SAR, submit a 3-1/2-inch diskette prepared using the computer word processing software authorized by SNL.

Final documents must be printed double-sided with 1-1/2-inch-wide margins and a 1-inch top margin. The text should end 1 inch from the bottom of the page, while the page number should be centered 1/2 inch from the bottom of the page.

Final copies are to be issued in 3-ring binders. If the document is prepared by a contractor, two unbound original copies of the SAR shall be provided to SNL for reproduction purposes.

In addition to hard-copy documents, the preparer must provide a diskette (3-1/2 inch) for the document in the computer word processing software specified by SNL.

NOTE: Because software may change in the future, be certain to consult the Risk Management and NEPA Department before selecting the computer software to be used for word processing for SARs.

No logos in the document!

No contractor logos or information on which company prepared the document shall appear anywhere in the document, except for the cover page.

Submit the above deliverables to:

Sandia National Laboratories
Risk Management and NEPA Department
P.O. Box 5800, MS 1037
Albuquerque, NM 87185-1037

CHAPTER 4

APPENDICES

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CHAPTER 4: APPENDICES

4.1 INTRODUCTION

Chapter 4 provides guidance on how and when to use appendices that contain supporting information relevant to the SAR, but that do not belong in the body of the SAR text.

Appendices for SARs should contain any additional information the preparers and writers deem relevant, but which would distract a reader if it were placed within the body of the text. Appendices are supporting parts of the document.

For example, reviewers may turn to data in an appendix if they want to delve deeper into how certain information in the SAR was derived. However, if these data had been placed up front in the text, readers would have been delayed or detoured as they waded through the data. Too complex data may even send readers in unintended directions. Complex data, calculations, graphs, lists of terms and definitions, etc. are examples of information that should be placed in appendices.

4.2 OBJECTIVES

The objective for this chapter is to illustrate the kinds of information that should be included in appendices rather than in the text of a SAR.

4.3 SCOPE

One appendix that a SAR should contain is a *List of Acronyms*.

Two related SNL documents that may be referenced in the SAR are:

- SAND89-0217, *Acronyms, Initialisms, and Abbreviations*
- SAND92-0192, *Environment, Safety and Health Glossary*

An alternative, if appropriate, to these longer lists would be a short list to be included in the preliminary part of the SAR.

NOTE: In the preliminary pages of this style guide, a *Glossary of Technical Terms* is provided because the list is short.

Another appendix that SARs should contain is a *Reference List of Applicable DOE Orders and Other Guidance Documents that Provide Necessary Guidance.*

APPENDIX A

A GUIDE TO APPLICABLE STATUTES, RULES, AND DOE ORDERS

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APPENDIX A: A GUIDE TO APPLICABLE STATUTES, RULES, AND DOE ORDERS

A.1 Objectives

Preparation of SARs is governed by three main categories of regulations, as applicable.

The objective of this appendix is to acquaint SAR preparers with the statutes, rules, and DOE orders governing the safety basis and operation of DOE nuclear facilities and operations. These documents should be thoroughly researched and their applicability determined for the subject facility or operation for which a SAR is required.

A.2 Scope

The scope of these regulations includes the following:

- Federal statutes, rules, and DOE orders;
- State and local statutes and ordinances; and
- Other appropriate ordinances and rules affecting the safe design, construction, operation, decontamination, and decommissioning of the facility.

Where appropriate, SARs should have brief discussions on the specific part(s) of regulations to be invoked.

A.3 DOE Orders and Other Departmental Requirements

For a specific facility, distinguish between applicable and nonapplicable requirements of federal documents.

The 5480-series of DOE orders specify the requirements for DOE-owned reactor and non-reactor nuclear facilities. In most cases, the DOE orders distinguish clearly between applicability to reactor and non-reactor nuclear facilities. If clarification is necessary, corresponding sections of the SAR should detail specific applicability of the requirement to the relevant system, component, or process.

A.3.1 DOE Orders

Paragraph 4.f(3)(d) of Attachment 1 of DOE Order 5480.23 requires that the SAR identify and show compliance with applicable statutes, rules, and DOE orders. Preparers and writers of SARs should review the DOE orders, or their latest revisions, presented in Table A-1 to determine the relevant requirements for any given facility:

Materials presented in the SAR must demonstrate compliance with all relevant federal DOE Orders.

Table A-1. Important DOE Orders Relevant to SARs

Order No.	Document Title
1300.2A	Department of Energy Standards Program
1540.2	Hazardous Material for Transport — Administrative Procedures
1540.3	Base Technology for Radioactive Material Transportation Packaging Systems
1540.4	Physical Protection of Unclassified Irradiated Reactor Fuel in Transit
4330.4A	Maintenance Management Program
4700.1	Project Management System
5000.3B	Occurrence Reporting and Processing of Operations Information
5400.1	General Environmental Protection
5400.2A	Environmental Compliance Issue Coordination
5400.3	Hazardous and Radioactive Mixed Waste Program
5400.4	Comprehensive Environmental Response, Compensation, and Liability Act Requirements
5400.5	Radiation Protection of the Public and the Environment
5440.1E	National Environmental Policy Act Compliance Program
5480.1B	Environment, Safety, and Health Program for Department of Energy Operations
5480.3	Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes
5480.4	Environmental Protection, Safety and Health Protection Standards
5480.5	Safety of Nuclear Facilities
5480.6	Safety of Department of Energy-owned Nuclear Reactors
5480.7A	Fire Protection
5480.9	Construction Safety and Health Program
5480.10	Contractor Industrial Hygiene Program
5480.11	Radiation Protection for Occupational Workers
5480.15	Department of Energy Laboratory Accreditation Program for Personnel Dosimetry
5480.17	Site Safety Representatives
5480.19	Guidelines for Conduct of Operations at DOE Facilities
5480.20	Personnel Selection, Qualification, Training, and Staffing at DOE Reactor and Non-reactor Nuclear Facilities
5480.21	Unreviewed Safety Questions
5480.22	Technical Safety Requirements
5480.23	Nuclear Safety Analysis Reports
5480.24	Nuclear Criticality Safety
5480.28	Natural Phenomena Hazards Mitigation
5481.1B	Safety Analysis and Review System
5483.1A	Occupational Safety and Health Program for DOE Contractor Employees at Government-owned, Contractor-operated Facilities
5484.1	Environmental Protection, Safety, and Health Protection Information Reporting Requirements
5500.1B	Emergency Management System

Table A-1. Important DOE Orders Relevant to SARs (Continued)

Order No.	Document Title
5500.2B	Emergency Categories, Classes, and Notification and Reporting Requirements
5500.3A	Planning and Preparedness for Operational Emergencies
5530.1A	Accident Response Group
5610.1	Packaging and Transporting of Nuclear Explosives, Nuclear Components, and Special Assemblies
5610.10	Nuclear Explosive and Weapon Safety Program
5610.11	Nuclear Explosive Safety
5700.6C	Quality Assurance
5820.2A	Radioactive Waste Management
6430.1A	General Design Criteria

A.3.2 Other DOE Regulations and Guidelines

Preparers and writers of SARs should also review the following documents to evaluate their specific applicability for a given facility:

ASDP Notice #13	*Defense Programs Environmental, Safety and Health Policy*
SEN-15-90	*National Environmental Policy Act*
SEN-35-91	*Nuclear Safety Policy*
Ex Order 12088	*Federal Compliance with Pollution Control Standards. DOE Radiation Standards for Protection of the Public in the Vicinity of DOE Facilities.* (W. A.Vaughn Memorandum, 5 August 1985)
N5400.10	*Sealed Radioactive Source Accountability*
N5480.6	*Radiological Control*
N5480.7	*Imposition of Proposed Nuclear Safety Requirements*
N5480.8	*Radiological Health and Safety Policy*

SAR preparers must ensure that not only DOE orders but other DOE regulations are met, and writers must make certain that material presentation is effective in conveying this fact.

DOE-STD-1027-92	*Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*
DOE-DP-STD-3005-93	*Evaluation Guidelines for Accident Analysis and Safety Structures, Systems, and Components (Draft)*
DOE-STD-3009-93	*Preparation Guide for US DOE Nonreator Nuclear Facility Safety Analysis Reports (Draft)*

A.3.3 Applicable Federal Rules and Regulations

The following federal laws, rules, and regulations (most recent versions) applicable to the design, construction, and operation of SNL nuclear facilities should be reviewed to determine their specific applicability:

Besides DOE orders and regulations, preparers and writers of SARs for SNL must also check other federal rules and regulations for applicability.

- American Conference of Governmental Industrial Hygienists: "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices," 1991-1992.
- American Industrial Hygiene Association, ERPG Committee: "Emergency Response Planing Guidelines," 1991.
- Clean Water Act, as amended.
- Code of Federal Regulations, Title 10, Energy, Part 1022: "Compliance with Floodplains/Wetlands Environmental Review Requirements," U.S. Government Printing Office, Washington, D.C.
- Code of Federal Regulations, Title 29, Labor, Part 1910: "Occupational Safety and Health Standards," U.S. Government Printing Office, Washington, D.C.
- Code of Federal Regulations, Title 29, Labor, Part 1926:"Safety and Health Regulations for Construction," U.S. Government Printing Office, Washington, D.C.

- Code of Federal Regulations, Title 40, Environment, Part 61, Subpart H: "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities," U.S. Government Printing Office, Washington, D.C.

- Code of Federal Regulations, Title 40, Environment, Part 125: "Criteria and Standards for the National Pollutant Discharge Elimination System," U.S. Government Printing Office, Washington, D.C.

- Code of Federal Regulations, Title 40, Environment, Parts 260 thru 265: "U.S. Environmental Protection Agency Regulations Implementing the Resource Conservation and Recovery Act," U.S. Government Printing Office, Washington, D.C.

- Code of Federal Regulations, Title 40, Environment, Parts 302 thru 304: "Implementing the Comprehensive Environmental Resource Conservation Liability and Recovery Act of 1980," U.S. Government Printing Office, Washington, D.C.

- Superfund Amendments and Reauthorization Act of 1986: "The Community Right-To-Know Act," Title III, Section 312.

A.3.4 Applicable State and Local Statutes, Ordinances and Regulations

Preparers and writers of SARs for SNL must not neglect nonfederal rules and regulations such as:

Preparers of SARs must also research State of New Mexico, Bernalillo County, and City of Albuquerque statutes relating to the environment, safety, and health protection, or comparable state, city, and county statutes where the facility is located. Those requirements applicable to the facility must be identified. This review should include the following documents:

State laws;

<u>New Mexico State Laws, 1978, Annotated</u>

- New Mexico Air Quality Control Act
- New Mexico Radiation Protection Act
- New Mexico Hazardous Waste Act
- New Mexico Radioactive and Hazardous Materials Act
- New Mexico Emergency Management Act
- New Mexico Hazardous Waste Feasibility Study Act
- New Mexico Hazardous Chemicals Information Act

- New Mexico Water Quality Act
- New Mexico Ground Water Protection Act
- New Mexico Environmental Compliance Act
- New Mexico Solid Waste Act

Bernalillo County Ordinances (as amended)

- Ordinance No. 303 — "Air Pollution," 5 August 1974

County ordinances; and

- Ordinance No. 88-45 — "Air Quality Control/Air Pollution," (no date)
- Ordinance No. 88-1 — "Bernalillo County Liquid Waste Disposal," 4 February 1988

City of Albuquerque Revised Ordinances, 1974 (as amended)

- "Air Quality Control Board," Article XVI, Chapter 6, *Health, Safety & Sanitation*, 1 April 1989
- "Chlorofluorocarbons," Article XX, Chapter 6, *Health Safety & Sanitation*, 1 April 1990

City ordinances.

- "Sewer Use and Waste Water Control," Article IX, Chapter 8, *Water, Sewer & Streets*, 1 October 1990
- "Cross-Connection Prevention and Control," Article XI, Chapter 8, *Water, Sewer & Streets*, 1 January 1988
- "Water Waste," Article XIV, Chapter 8, *Water, Sewer & Streets*, (no date)

For SNL facilities located in areas other than Albuquerque, NM, the SAR preparer must identify the applicable state and local environment, safety, and health requirements.

APPENDIX B

A GUIDE TO PRINCIPAL HEALTH AND SAFETY CRITERIA

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APPENDIX B: A GUIDE TO PRINCIPAL HEALTH AND SAFETY CRITERIA

B.1 Objectives

The objective of this appendix is to identify for SAR preparers and writers the specific DOE orders and the codes and standards containing the health and safety criteria applicable to the facility or operation.

B.2 Scope

The scope of applicable health and safety criteria covers the following:

The scope encompasses several important facility systems.

- Confinement barriers and systems;
- Waste handling and treatment systems;
- Effluent treatment systems;
- Ventilation and offgas systems;
- Equipment and process safety instrumentation systems;
- Process monitoring and alarm systems;
- Fire protection systems; and
- Radiation protection systems.

B.3 Citations in the SAR of Safety Requirements Documentation

Citing of health and safety references and requirements documentation in the SAR constitutes a facility "commitment."

Citation of health and safety requirements documentation, as well as other supporting documentation, in the SAR constitutes a *commitment* by facility management. Such citations (and commitments) must be well-focused and limited to those specific aspects of the document related to control of the hazards or operational safety issues at the facility.

Therefore, preparers of SARs must ensure that referenced documents include:

- A revision designator;
- Date of issue; and
- Any other information that defines the applicable version of the document to which the facility is making commitments.

B.4 Safety Criteria Relevant to Structures, Systems, and Components

The criteria that apply specifically to structures, systems, and components fall into six main categories:

- General facility design;
- Radiation protection barriers;
- Fire protection;
- Nuclear criticality safety;
- Hazardous waste management; and
- Worker health and safety.

B.4.1 General Facility Design Criteria

Requirements for general facility design are given in DOE Order 6430.1A.

DOE Order 6430.1A, *General Design Criteria*, contains general design requirements for:

- Building acquisition;
- New facilities; and
- Facility additions and modifications.

Writers should include in appropriate SAR sections a discussion of any non-compliance with the health and safety requirements of this order.

Writers should also consult:

1991 UBC
ASCE7-88
UCRL-15910
UCRL-53582
UCRL-53526
UCRL 53851

New SNL facilities must also be designed to meet the following criteria:

- 1991 Uniform Building Code (UBC) requirements for Seismic Risk Zone 2B, and
- Requirements of ASCE7-88 for minimum design loads (excluding seismic loads).

The requirements of UCRL-15910, *Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards, and its corresponding supporting documents for each of the natural phenomena hazards* (i.e., UCRL-53582 for earthquakes, UCRL-53526 for extreme winds, and UCRL-53851 for floods) should be used where they are more stringent than the UBC and ASCE7-88 requirements.

B.4.2 Radiation Protection Barriers Criteria

Consult these radiation protection barriers guidelines:

ICRP Report 26
DOE Order 5400.5
DOE N5480.6
DOE Order 5480.11
ANS 6.4
ANS 6.4.2
ACI 349

Preparers and writers of SARs should become familiar with the structural design criteria for mitigating the effects of ionizing radiation, such as shielding. These criteria limit the radiation exposure to workers. The SAR should convey that conformance to these criteria is based on analysis of potential radiation exposures and on application of appropriate Quality Assurance principles to design and construction activities.

In the operational phase, the SAR should convey that implementation of *Sandia's Radiation Protection Program* ensures continuous monitoring of facility operations to meet dose limitation criteria. In the Radiation Protection and Quality Assurance topics in the SAR, the writer should describe the specific activities that assure conformance to the prescribed dose criteria.

Preparers and writers of SARs also need to become familiar with the criteria governing the maximum permissible radiation worker exposure and the application of as-low-as-reasonably-achievable (ALARA) principles. These criteria are contained in the following documents:

- ICRP Report No. 26 (use of weighting factors);
- DOE Order 5400.5, *Radiation Protection for the Public and the Environment* (limits for public exposure following a design basis accident);
- DOE N5480.6, *DOE Radiological Control Manual* (guidelines on radiological control); and
- DOE Order 5480.11, *Radiological Protection for Occupational Workers* (occupational external exposure limits).

More information on applicable requirements is contained in Chapters 7 and 8 of the *Sandia National Laboratories ES&H Manual.*

Other requirements applicable to structural components that provide radiation shielding are found in ANS 6.4, ANS 6.4.2, and ACI 349.

B.4.3 Fire Protection Criteria

The main DOE orders governing fire protection are DOE 5480.7 and DOE 6430.1A.

The primary DOE document specifying fire protection requirements is DOE Order 5480.7, *Fire Protection.* Other applicable requirements are contained in DOE Order 6430.1A, *General Design Criteria.* A general description of the facility's fire protection systems should be included in the Operational Safety chapter of the SAR.

More detailed descriptions of fire protection systems, equipment, and operation should be included in the appropriate section(s) of the SAR. Criteria for fire protection systems are contained in the following standards:

- NFPA 80A (building exterior);
- NFPA 101 (distance to fire exit, emergency lighting,etc.);
- NFPA 80 (fire doors, frames and hardware);
- NFPA 13 (sprinkler systems);
- NFPA 71, NFPA 72A to 72H (fire detection and alarm devices);
- NFPA 24 (fire service water mains); and
- NFPA 20 (fire pumps).

Also become familiar with these other guidelines.

More information on applicable requirements can be found in Chapter 5 of the *Sandia National Laboratories ES&H Manual.*

B.4.4 Nuclear Criticality Safety

Become familiar with nuclear criticality references.

Writers should describe in the Inadvertent Criticality Protection topic in the SAR those specific activities that assure conformance to nuclear criticality safety requirements. The minimum design requirements for nuclear criticality controls, including equipment and procedures, are specified in:

- DOE Order 5480.5, *Safety of Nuclear Facilities*;
- ANSI N16.1; and
- ANS 8 series (on nuclear criticality safety).

More information on applicable requirements is contained in Chapter 14 of the *Sandia National Laboratories ES&H Manual.*

B.4.5 Hazardous Waste Management

Consult these references for hazardous waste management requirements:

DOE Order 5400 series
DOE Order 5480 series
40 CFR 264
40 CFR 265
40 CFR 268

Preparers and writers of SARs should become familiar with the hazardous waste requirements given in chapter 2 of DOE Order 5480.1B, *Environment, Safety, and Health Program for Department of Energy Operations.*

In addition, 40 CFR 264 and 40 CFR 265 contain specific design and operating requirements and standards for owners and operators of hazardous waste treatment, storage, and disposal facilities.

Land disposal restrictions and treatment standards for hazardous wastes are given in 40 CFR 268.

Mixed wastes must be segregated and handled separately from other types of waste in accordance with DOE Order 5400.3, *Hazardous and Radioactive Mixed Waste Program.*

Facility design must provide for the segregation of hazardous wastes into compatible groups for storage in accordance with the DOE 5400 series and 5480 series of orders.

More information on applicable requirements is contained in Chapters 12 and 19 of the *Sandia National Laboratories ES&H Manual.*

B.4.6 Other Worker Health and Safety Criteria

Study these guidelines before preparing and writing worker health/safety information for the SAR:

DOE Order 6430.1A
DOE Order 5480.10
ASME N510
ANSI N13.1
ANSI N2.3

General ventilation requirements for the facility are contained in DOE Order 6430.1A, *General Design Criteria.*

In addition, writers should become familiar with the following criteria:

- ASME N510 (in-place testing requirements for HEPA filtration systems);
- ANSI N13.1 (requirements for radiation air monitoring systems);
- ANSI N2.3 (design, installation, and testing requirements for radiation warning and alarm systems);

ANSI Z88.2
29 CFR 1910.134

- ANSI Z88.2 and 29 CFR 1910.134 (breathing air supply system requirements); and
- DOE Order 5480.10, *Contractor Industrial Hygiene Program* (other health and safety requirements).

Additionally, the facility must operate in compliance with the federal laws and industry standards listed below.

Also ensure that SAR submissions meet these CFR and industry references.

- Code of Federal Regulations, Title 29, Part 1910, "Occupational Safety and Health Standards";
- Code of Federal Regulations, Title 29, Part 1926, "Safety and Health Regulations for Construction"; and
- American Conference of Governmental Industrial Hygienists, 1991-1992.

More information on applicable requirements is contained in Chapters 4 and 6 of the *Sandia National Laboratories ES&H Manual.*

B.5 Natural Phenomena Design Criteria

Natural phenomena include seismic, wind, tornado, flood, and snow and ice conditions. Criteria specific to these natural phenomena govern the design of nuclear facilities. These criteria are discussed in the subsections that follow.

B.5.1 Seismic Criteria

Albuquerque and SNL are in Seismic Risk Zone 2B.

Preparers and writers of SARs should be aware that the Albuquerque area and SNL are located in Seismic Risk Zone 2B, a region that can be expected to receive moderate earthquake damage. UCRL-53582 indicates that seismic evaluation of the facility should be based on a maximum ground acceleration of **0.22g**.

For seismic design of SNL nuclear facility structures and systems, a two-category classification has been established: Category I and Category II.

Category I structures/systems

Category I structures and systems must remain functional following a seismically induced accident so as to ensure that the radiation exposure to personnel is consistent with 10 CFR Part 100. The seismic event associated with Category I is defined as the safe shutdown earthquake (SSE).

Category II structures/systems

Category II structures and systems must remain functional following a seismically induced accident to ensure operational control of the facility. The failure of Category II structures and systems does NOT result in the release of significant amounts of radioactive material or prevent safe facility shutdown. The seismic event associated with Category II is defined as the operating basis earthquake (OBE).

Based on the design basis accident (DBA) analyses for SNL Technical Area V nuclear facilities, the downwind radiation exposures at the exclusion area boundary (3,000 meters) would not exceed the 10 CFR 100 guidelines. Therefore, for these facilities, the DBE is the OBE.

B.5.2 Wind Criteria

Extremely high sustained winds are atypical for the Albuquerque area, although wind gusts of 101 mph (45 m/sec) have been observed at SNL. The SNL's nuclear facilities have survived such wind gusts without damage or threat to their structural integrity.

UCRL-53526 governs SNL facility design for extreme wind conditions.

Design for extreme wind conditions at SNL facilities should be based on UCRL-53526. Wind loadings for low hazard facilities should be calculated using a wind speed of 81 mph and importance factor of 1.07. For moderate-hazard facilities, wind loadings should be based on a wind speed of 93 mph and an importance factor of 1.0. For high- hazard facilities, wind speed should be 107 mph and the importance factor should be 1.0.

B.5.3 Tornado Criteria

Tornado phenomena is not an issue for SNL.

Albuquerque is classified as a region of low occurrence for tornadoes, per UCRL-15910. Thus, this phenomenon is not applicable to SNL facilities.

B.5.4 Flood Criteria

Consult UCRL-53851 for flood criteria.

In accordance with UCRL-53851, the 100-year flood criteria is based on 5 inches of rain per hour. Although the Albuquerque climate is generally dry, half of the annual precipitation of approximately 8 inches occurs as brief but heavy thunderstorms from July through September. As a consequence, only SNL nuclear facilities located near arroyos will need to consider the applicability of this phenomenon in their accident analysis.

Temporary flood conditions are not unusual following heavy thunderstorms. Thus, the consequences of stormwater run-off may need to be considered for applicability during the facility accident analysis.

B.5.5 Snow/Ice Criteria

Snow and ice are not a problem for SNL.

An appropriate loading criterion for snow or ice accumulation is 6 pounds per square foot. This criterion is conservative because the climate of the region is generally mild. Snow in Albuquerque rarely lasts longer than 24 hours, and the average annual accumulation of snow is 14.7 inches. Thus, snow/ice loadings are not an issue for SNL nuclear facility accident analyses.

B.5.6 Operational Health and Safety Criteria

Requirements to ensure worker health and safety during facility operations are contained in various federal rules and regulations, DOE regulations, and state and local statutes and ordinances.

Conformance with applicable requirements is assured through implementation of the following SNL controls:

In appropriate SAR sections, writers must include discussions of SNL's ES&H controls.

- Radiological Control Manual;
- ES&H Manual;
- Management Integration and Implementation Plan; and
- A variety of facility-specific Standard Operating Procedures (SOPs).

Include in the appropriate sections of the SAR discussions of these operational controls at SNL (e.g., in the sections addressing radiation and hazardous material protection, organizational safety programs, procedures and training, operational safety, quality assurance, etc.).

B.7 Emergency Preparedness Criteria

Requirements for emergency preparedness at applicable SNL facilities are contained in:

Consult these guidelines to ensure SAR submissions meet emergency preparedness requirements.

- DOE Order 5500.1B, *Emergency Management System*;
- DOE Order 5500.2B, *Emergency Categories, Classes, and Notification and Reporting Requirements*; and
- DOE Order 5500.3A, *Planning and Preparedness for Operational Emergencies*.

More information on applicable requirements is contained in Chapter 15 of the *Sandia National Laboratories ES&H Manual.*

Conformance to these requirements is assured by SNL's Emergency Preparedness Program, which is to be described in the Emergency Preparedness chapter of the SAR.

DOE Order 6430.1A, *General Design Criteria*, specifies the following NFPA and IEEE standards that are applicable to standby and emergency systems:

Address adherence to these five guidelines in the Quality Assurance and Emergency Preparedness chapters of the SAR.

- NFPA 101, *Life Safety Code;*
- NFPA 110, *Emergency Power Supplies;*
- NFPA 37, *Stationary Combustion Engines and Gas Turbines*;
- NFPA 70, *National Electric Code*; and
- IEEE 446, *Recommended Practice for Emergency and Standby Power Systems.*

The specific activities that assure conformance with these standards should be addressed in the Quality Assurance and Emergency Preparedness topics of the SAR.

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APPENDIX C

A GUIDE TO PSAR VS FSAR CONTENT

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APPENDIX C: A GUIDE TO PSAR VS FSAR CONTENT

Following is a comparison of the requirements differences between PSARs and FSARs. The comparison covers all topics DOE requires be covered in SARs.

Executive Summary

PSAR

Describe PSAR focus:

- Preliminary design
- Procurement
- Construction
- Pre-op testing

Summarize primary bases for design and construction acceptability, including applicable DBE, DBW, and DBFL design criteria; discuss anticipated hazards to be encountered and results of preliminary assessment of their impact on facility mission and planned operations.

FSAR

Describe FSAR focus:

- As-built design and construction
- Process operations
- Facility operating plans and programs (maintenance of facility design/safety bases)

Summarize potential hazards assessed, results of design basis accident (DBA) analyses, and associated control measures for assuring safe facility operation. Summarize significant decontamination and decommissioning plans and issues.

Site Characteristics

PSAR/FSAR (Hazard Category 3)

For Hazard Category 3 facilities, this discussion should be focused within the site boundaries. Discussion of meteorological conditions, hydrology, off-site population information, etc. is not required, since unmitigated accident consequences are, by definition, limited to the facility itself.

PSAR (Hazard Categories 1 & 2)

Describe general site characteristics with special emphasis on those characteristics influencing design and construction of the facility.

FSAR (Hazard Categories 1 & 2)

Describe site characteristics that influence both the design and operation of the facility, including anticipated and worst-case parameters necessary for modeling the on-site and off-site consequences due to normal and accidental releases of hazardous materials to the environment.

Facility Description and Operation

PSAR	FSAR
Describe facility function and primary processes for accomplishing this function, including design of principal structures, systems, and components (SSCs); describe general operation of primary facility systems, design characteristics and operation of engineered safety features (ESF), and other safety-class and safety-significant systems and equipment; provide simplified process, system, and equipment drawings, as necessary, to enable qualified reviewers to verify conformance with safety design bases, codes, standards, and commitments.	Expand on the level of detail described for the PSAR, including delineation of plans, provisions, and maintenance, and surveillance (information should be of principal safety criteria, selection of engineered safety features, and accident analysis). System descriptions should include auxiliary, utility, instrumentation, and control systems necessary for ESF and other safety-class and safety-significant systems and equipment to perform their functions. Describe specific conditions under which ESF must function and associated performance criteria derived from accident analyses.

NOTE: The scope of this discussion and the level of detail provided should be tailored to the complexity of the facility and the systems being relied upon to maintain an acceptable level of risk. In addition, Hazard Category 3 facilities will not have safety-class SSCs and may have only safety significant SSCs that contribute to worker safety.

Hazard Identification and Facility Classification

PSAR	FSAR
Discuss anticipated hazardous material inventories, as well as maximum quantities to be used in establishing the DBA envelope; discuss anticipated energy sources and potential release processes; establish basis for facility hazard classification.	Discuss actual hazardous material inventories, as well as maximum quantities used to establish the DBA envelope; discuss actual energy sources and probable release processes and pathways for accident analyses; establish basis for facility hazard classification.

Radioactive and Hazardous Material Waste Management

PSAR	FSAR
Discuss potential sources, quantities, and characteristics of wastes anticipated to be generated from facility operations, along with plans and provisions for management of these wastes (include design and general operating characteristics of waste management processes, systems, and equipment).	Discuss actual sources, quantities, and characteristics of wastes generated from facility operations; discuss overall philosophy, objectives, and general process for handling radwaste and mixed waste forms, including administrative and operational controls; describe operating principles, functions, and performance objectives of waste handling equipment and systems.

Inadvertent Criticality Protection

PSAR/FSAR (Hazard Category 3)

This chapter is not applicable since, by definition, Hazard Category 3 facilities do not contain sufficient fissile materials to present a criticality hazard.

PSAR (Hazard Categories 1 & 2)	FSAR (Hazard Categories 1 & 2)
(If no fissionable material is in the facility, then this chapter is not applicable.) Address criteria to ensure subcritical conditions are maintained for fissionable material to be received, handled, processed, used, or stored in facility under worst credible conditions; discuss criticality safety design limits and parameters to be used for prevention and control of criticality for activities involving fissionable material.	(If no fissionable material is in the facility, then this chapter is not applicable.) Expand on the level of detail described for the PSAR by discussing application of the Double Contingency Principle for criticality safety per ANSI/ANS 8.1 (1983); discuss criticality safety design limits, their bases, and any design criteria used to ensure that criticality safety limits are not exceeded; discuss the error contingency criteria selected for the facility and criteria for establishing criticality protection verification.

Radiation Protection

PSAR	FSAR
Address management commitments to ensure compliance with radiation protection requirement of DOE Order 5480.11 when facility begins operation; describe specific facility design features that minimize worker radiation exposure.	Expand on information described above for PSAR by addressing specific implemented activities and programs for ensuring compliance with programmatic requirements of DOE Order 5480.11 as outlined on Pages 29 and 30 of Attachment 1 to DOE Order 5480.23.

Hazardous Material Protection

PSAR	FSAR
Address, in appropriate sections of the PSAR, commitment to ensure compliance with applicable requirements for control of personnel exposures to hazardous materials when the facility begins operation.	Expand on information described above for the PSAR by addressing specific implemented activities and programs for ensuring compliance with applicable requirements for control of personnel exposures to hazardous materials (include ALARA bioassay/medical monitoring, air monitoring, workplace monitoring, hazardous material exposure record-keeping, monitoring instrumentation maintenance and calibration, and hazard evaluation, elimination, and communication).

Accident Analysis

PSAR	FSAR (Hazard Category 3)
Include sufficient accident analysis to provide reasonable assurance that all appropriate safety issues have been identified and that resolutions will be feasible in the design and operation of the facility.	Summarize the maximum consequences expected from facility operation and state that detailed accident quantification is not necessary because potential consequences are, by definition, well below off-site evaluation guidelines.

	FSAR (Hazard Categories 1 & 2)
	Identify the spectrum of accident sequences/scenarios that release hazardous materials from the facility; discuss criteria for selection of sequences analyzed and of accidents used to provide design parameters for release barriers and mitigating systems (DBAs); address results of accident analyses for nearby facilities that may impact facility operations or personnel. Except for Hazard Category 2 facilities that do not exceed off-site evaluation guidelines, discuss results of beyond-DBA analysis and assessment of risk reduction achieved by protecting against beyond-DBAs; discuss derivation of measures of importance-to-risk or importance-to-safety used to develop hierarchy of safety functions for the facility; discuss derivation of environmental qualification requirements for safety-class equipment.

NOTE: The level of rigor applied to the performance and documentation of accident analyses is dependent on the magnitude of the hazards being analyzed. That is potentially high consequence hazards necessarily require more rigorous analysis than low consequence hazards to establish an acceptable risk envelope for the facility.

Management, Organization, and Institutional Safety Provisions

PSAR	FSAR (Hazard Categories 1, 2, & 3)
Describe management structure of organizations dedicated to facility design, construction, and pre-operational testing; discuss mechanisms for: 1) ensuring effective inter-organization coordination and communication with respect to identification, evaluation, and resolution of safety issues; 2) controlling changes to facility design and construction; and 3) occurrence reporting during construction and pre-operational	Expand on the level of detail described for the PSAR to include facility operations; discuss organization responsibilities and interfaces among subgroups responsible for different aspects of safety, including engineering, procurement, construction, startup, operations, maintenance, quality assurance, compliance determination, training, etc,; discuss mechanisms for 1) independent review and appraisal of facility safety performance, 2) selection of operating

testing. Include commitments concerning the management structure during facility operation.

plans, 3) selection of short-term and long-range surveillance and maintenance plans, and 4) facility configuration and document control; address staffing levels, job candidate qualification and fitness-for-duty requirements for safety-related operational positions; identify programs or provisions to monitor performance of operational personnel and to enhance performance through team-building, feedback, etc., supplemental to normal line management and training provisions.

The scope of this discussion and the level of detail should be tailored to the complexity of the facility and the magnitude of the associated hazards. That is, facilities of relatively low complexity having relatively low consequence hazards [necessarily Hazard Category 3] will not require elaborate treatment of these topics.]

FSAR (Hazard Categories 1 & 2)

Identify bases for minimum shift manning, including required knowledge, skills and abilities; discuss bases for allocating operational, emergency response, and monitoring functions to on-shift, on-site, on-call, or intermittent positions.

Procedures and Training

PSAR	FSAR
Describe processes by which technical content of written procedures and training materials are to be developed, verified, and validated; discuss management commitments to training programs that comply with requirements of DOE Order 5480.20.	Describe processes by which technical content of written procedures and training materials are developed, verified, and validated; discuss mechanisms to identify and correct technical or human factors deficiencies in written procedures through experience accumulated in training programs, personnel examinations, and facility operating experience; describe provisions to assure configuration control of procedures and to ensure necessary personnel training is accomplished prior to introduction of new procedures or of changes in human-machine interfaces in procedures; describe initial and continuing training programs for normal abnormal operations and emergency conditions, and organizational responsibilities for conduct of training and maintenance of training record; describe methods used to derive training program content, methods used to accomplish training, qualification requirements for training instructors, qualification requirements for operators, maintenance, and technical support personnel, certification requirements, methods used to analyze and factor operating experience into training programs, and methods used to analyze and factor operating experience into training programs, and methods used to evaluate and improve effectiveness of training programs; and demonstrate that procedures and training requirements will have been met before operations begin.

Human Factors

PSAR	FSAR
Discuss sufficiency of furnished instrumentation provisions for communication, and operational aids to support timely, reliable performance of human operations important to safety; describe design , layout, and labeling of facility controls and instrumentation; discuss other design aspects of the workplace environment intended to enhance reliability of personnel performing tasks of importance to facility safety.	Expand on the level of detail described for the PSAR by addressing provisions to ensure reliable restoration of safety-significant equipment following calibration, maintenance, testing, or other operations requiring temporary removal from service; discuss provisions for recovery from restoration errors; describe provisions to reduce information processing, interpretation, and decision-making by operating personnel during abnormal events; describe types and frequency of on-site practice and experience in mitigating abnormal events for operating personnel.

Initial Testing, Inservice Surveillance, and Maintenance

PSAR/FSAR (Hazard Category 3)

Since Hazard Category 3 facilities only have the potential for significant localized consequences the discussion of initial testing, surveillance, and maintenance is expected to apply only to the extent that the facility includes safety-significant SSCs requiring a support program to assure their functionality.

PSAR (Hazard Categories 1 & 2)	FSAR (Hazard Categories 1 & 2)
Describe plans and provisions for initial acceptance, startup, surveillance, and inservice testing, documenting the scope of tests along with an assessment of testing adequacy (include frequency and timing of tests) in the context of the provisions and capabilities for performing maintenance and repair work; discuss the development of surveillance test program elements based on evaluation of safety-significant equipment failure modes that could be detected by planned testing, and how these tests provide realistic validations of safety function performance under accident conditions; discuss surveillance testing limitations that	Expand on the information provided in the PSAR by describing 1) the maintenance management program philosophy, objectives, and organization, 2) assignment of responsibilities for specific maintenance functions within the maintenance organization, 3) structures, systems, and equipment included in the formal maintenance program, 4) management systems used to control maintenance activities, and 5) interfaces between maintenance and other facility organizations; discuss limitations and repair of safety-significant structures, systems, and equipment, and the plans, provisions, or

warrant compensatory measures, such as equipment environmental qualification requirements, special analyses, etc.; discuss management commitments to achieve compliance with the requirements of DOE Order 4330.4A, "Maintenance Management Program."

compensatory measures developed to minimize associated risks.

Derivation of Technical Safety Requirements

PSAR	FSAR
Address methodology to be used in developing a TSR basis and the management commitments to achieve compliance with requirements of DOE Order 5480.22, *Technical Safety Requirements.*	Discuss the basis for determining the facility operating envelope, addressing potential modes of operation, anticipated tests and experiments, anticipated maintenance and surveillance activities, established set points and operational parameters, staffing and qualification requirements for operating personnel, and limitations of administrative controls; provide sufficient information to establish bases for Safety Limits, Limiting Control Settings, Limiting Conditions for Operation, and Surveillance Requirements for all safety-class systems and components to be included in the TSRs.

Operational Safety

PSAR	FSAR (Hazard Categories 1, 2, & 3)
Address management commitments to achieve compliance with the requirements of DOE Order 5480.19, "Conduct of Operations Requirements for DOE Facilities."	Discuss the bases for facility conduct of operations, including operations philosophy, organization, administration and practices, internal communications, controlled area activities, notifications and reporting practices, abnormal event investigation practices, control of system and equipment status, independent verification practices, and control of operations procedures; describe provisions for radiation and hazardous material protection of personnel during operation, maintenance, and surveillance activities.

	FSAR (Hazard Categories 1 & 2)
	Include in the bases for facility conduct of operations discussion of shift routines, control of on-shift training, and shift turnover practices; identify and verify sufficiency of, safe storage and criticality safety requirements for special nuclear materials stored within facility; verify sufficiency of provisions for radiation and hazardous material protection of emergency response personnel during facility emergencies.

Quality Assurance

PSAR	FSAR
Describe elements of the QA program applicable to facility design, construction, and initial acceptance testing, including but not necessarily limited to: 1) QA organization, responsibilities, authority, and communication links, 2) design document and change control processes, 3) control of purchased items and services, 4) inspection and testing, 5) control of measuring and test equipment, 6) identification and control of nonconforming items, 7) handling, storage, and shipping controls, 8) corrective actions for identified conditions adverse to quality, 9) quality audits, and 10) QA records.	Expand the scope of the discussions presented in the PSAR to encompass facility operation, maintenance, and surveillance testing activities; describe additional elements of the QA program including but not necessarily limited to 1) personnel training and qualification, 2) instruction, procedure, and drawing control, 3) surveillance testing, 4) control processes, and 5) quality improvement.

Emergency Preparedness

PSAR/FSAR (Hazard Category 3)

Address the facility response to emergencies from adjacent facilities, if the facility is affected by accidents within an adjacent facility and an appropriate emergency response is not already adequately covered in the adjacent facility's SAR. In addition, emergency plans for facility emergencies should be discussed.

PSAR (Hazard Categories 1 & 2)	FSAR (Hazard Categories 1 & 2)
Address management commitments to achieve compliance with the emergency planning/response requirements contained in DOE Orders 5500.1B, 5500.2B, and 5500.3A.	Discuss facility emergency preparedness philosophy, objectives, and organization of emergency preparedness functions; describe activation process for emergency organizations, assessment activities, notification processes, location and operation of emergency facilities and equipment, emergency response personnel training, conduct of drill exercises, and emergency recovery and demobilization process.

Provisions for Decontamination and Decommissioning

PSAR	FSAR
Address how design and planning of facility construction and operation have given adequate consideration to ways in which the facility may require decontamination and ultimate decommissioning.	Describe conceptual plans for facility decontamination and decommissioning; include structural and internal features that facilitate D&D, the management of radiological and hazardous waste materials generated during D&D operations, and sources of D&D funding; address how planning of facility operations and evaluation of facility vulnerabilities to a spectrum of events (including accidents) avoids unnecessary burdens, minimizes site or environmental contamination, and precludes any increase in residual risks during or after decommissioning.

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